Advant® OCS
with Master software

Advant® Controller 110

Version 2.2

User's Guide Parts 1 and 2

3BSE 009 131R0101

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Chapter 1 Introduction

1.1 Before You Begin

Advant OCS is a system for industrial automation. It consists of a family of computer-based units and a local area network for communication.
A controller is a computer-based unit in which control applications are running.

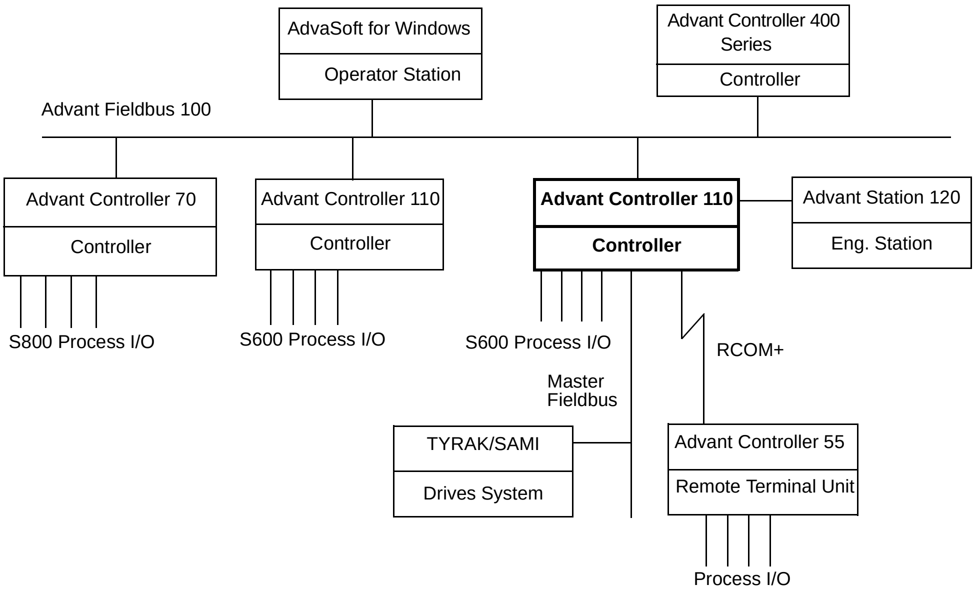


Figure 1-1. Example of Advant Open Control System with Advant Controller 110

Advant Controller 110 (AC 110) is a medium sized controller for mixed binary, regulatory, and supervisory control. It can be used as a stand alone station or as an integrated controller in a distributed control system, communicating with other components of the Advant Open Control System (see Figure 1-1).

This manual is intended primarily for plant designers and commissioning and maintenance personnel, providing them with information about the Advant Controller 110 system, its capabilities, and its limitations.
References are made to other manuals when necessary. Section 1.3, How to Use This Book provides further details about both this manual and other related manuals.

1.2 Equipment Requirements

Not relevant to this type of system product.

1.3 How to Use This Book

Basic Structure

This book is organized into chapters and sections as shown in Figure 1-2. Each document describing and referencing hardware is built around this structure to make it easy for you to locate related information in any of the documents. Since this one structure is not completely applicable to all type of hardware, certain sections contain only very brief statements in some documents. Small divergences from the standard structure are given in italics in Figure 1-2.

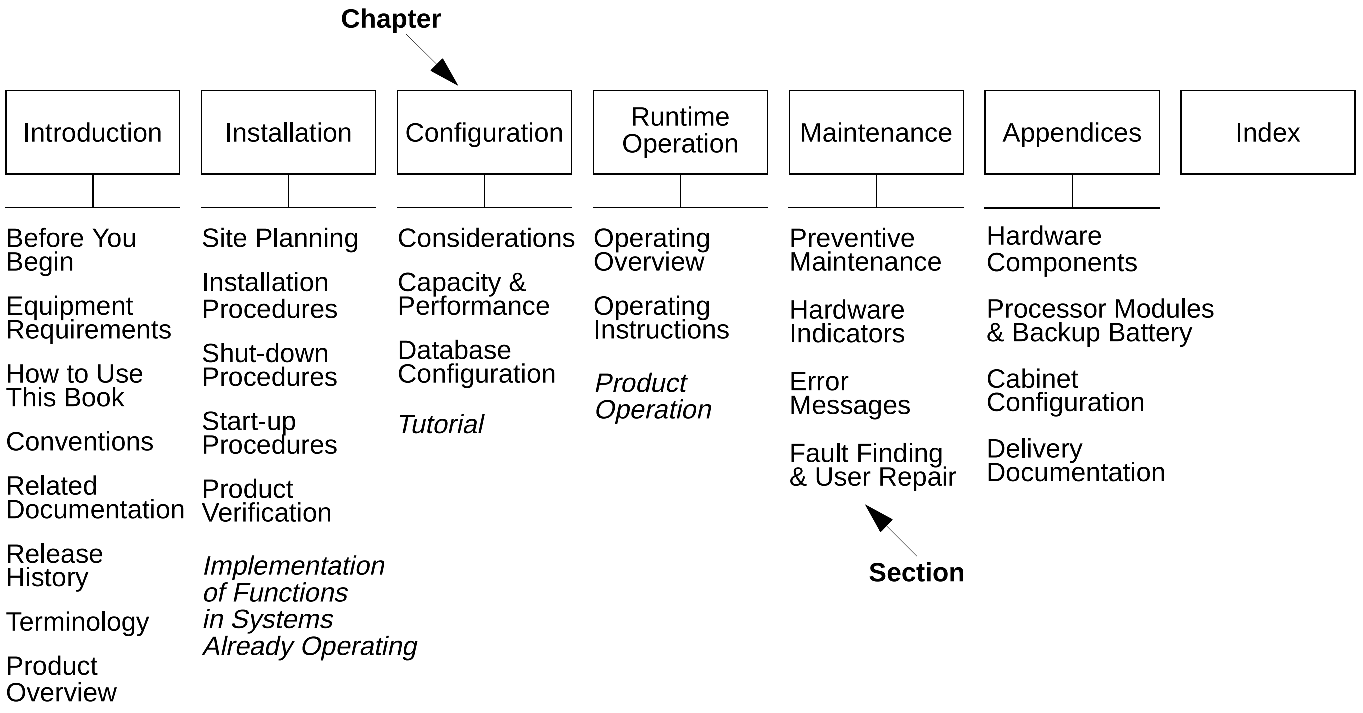


Figure 1-2. Hardware Manual Organization Structure

The substructure of product description in Section 1.8, Product Overview is also followed in other sections describing, for example, Considerations and Capacity & Performance. This is done to make it easy for you to find the information you need about different activities.

Because of the activity-oriented structure of the document, you may find information regarding an actual function distributed to, for example, Overview, Configuration, Operation. Sometimes you can find device information gathered in the hardware descriptions in the appendices.

Introduction

Chapter 1 (this chapter) provides introductory and background information, including

- Guidelines on how you can find information in this manual.
- This manual’s relationship to other Advant Controller 110 documents.
- A glossary defining terms frequently used in this manual.
- A product and functional overview: what Advant Controller 110 can do and how it works.

Installation

Chapter 2 guides you through various installation activities:

- Section 2.1, Site Planning. This section contains guidelines for planning installation of the product, outlining what you need to think about when you plan an installation. It does not, however, provide the complete list of measures to take. You can find descriptions of alternative solutions, design considerations, and so on, elsewhere in this manual.
- Section 2.2, Installation Procedures. This section gives you concrete information on how to set up the product. It includes safety regulations, handling and unpacking instructions, inspection and assembly procedures, cable routing and connections, switch settings and jumper positions, setup procedures, and so on You can find common instructions as well as instructions for specific subsystems in this section. Activities prior to power-up are also described.
- Section 2.3, Shut-down Procedures. This section provides, in addition to some safety regulations, basic shut-down procedures. You should know how to shut down the product if there is a problem with initial power-up.
- Section 2.4, Start-up Procedures. In Section 2.2, Installation Procedures, the conditions and the preparation necessary to begin are discussed. In Section 2.4, Start-up Procedures, you can find basic power-up procedures, i.e., how to apply power to and initialize the system. Information is also given on how you can verify a correct start. You can find information on activities up to “ready for application program loading” in this section.
- Section 2.5, Product Verification. This section tells you how to make an initial determination that the product is functional. This includes application program loading as well as commissioning information.
- Section 2.6, Implementation of Functions in Systems Already Operating. This section gives you the information you need to determine when, for example, to add an I/O board to a running system. Important on-line, off-line aspects are discussed.

Configuration

Chapter 3 gives you detailed information about how to obtain a desired function. The main information is structured as follows:

- Section 3.1, Considerations. You can find design guidelines, including design rules, in this section. Keywords include the following:
  - Limitations
  - Combinations of options
  - Module assortment supported by the system product
  - Location
  - Necessary extra HW and SW needed with respect to desired functionality
  - CPU load calculation
  - Memory calculation.

- Section 3.2, Capacity and Performance. In this section, technical data of the following types, for example, are discussed:
    - Maximum number of instances
    - Dimensions
    - CPU-load data
    - Memory capacity.
- Section 3.3, Database Configuration. In this section appropriate reference documents are listed.
- Section 3.4, Tutorial. This Section provides you with a guide through the different phases of a controller design project.

Runtime Operation

This chapter addresses the controller's different start modes and working modes. The operator interface on the processor module front is described.

In this chapter, you can also find a survey of the system software. Some important facilities that you need to know during application work are described in greater detail.

Maintenance

The preventive maintenance required for electronic equipment is not significant. This chapter focuses on fault finding supported by built-in diagnostics. Various methods of fault announcement are presented, including the use of error report in the Engineering Station, system status in the operator station, and LEDs on controller hardware units.

Appendices

Informations which do not fall into other categories within this manual's structure are included in the appendices. Examples are:

- Controller hardware descriptions
- Item designations in cabinets
- Description of delivery documentation
- Blanks for use during design work, for example, calculation of heat dissipation.

Index

The Index offers you an easy and quick way to find answers to specific questions.

1.4 Conventions

Not relevant in this document.

1.5 Related Documentation

This manual is the main document of the system product Advant Controller 110. Many of the available options are briefly described in this manual. For additional detailed information about options, see the appropriate individual manuals. Special subjects are also thoroughly treated in separate documentation.

1.6 Release History

1.6.1 Release Designation

This manual describes the Advant Controller 110 as a product.

The complete standard product including software, hardware and documentation is designated Advant Controller 110*2.2/X. X is the number for the revision.

The software included consists of base software and several software options. All base software and software options are designated in principle in the same way, for example, BASE SW*2.2/0.

The designation of a complete standard product or a program module is divided into two parts by an asterisk.

The first part consists of a product name. The second part consists of a release number, minor release number and revision number. See Figure 1-3.

The options display on the configuration tool indicates, upon connection to the system, the current product releases of the program modules.

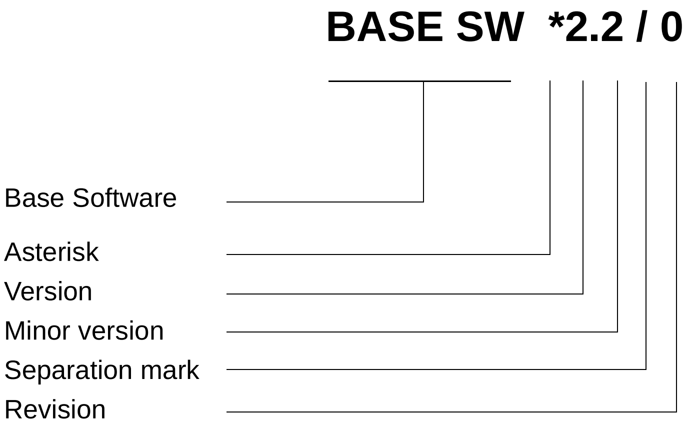


Figure 1-3. Example of Release Designation for Base Software

1.6.2 Product Releases

From a system viewpoint, the new controller is fully compatible to its previous versions. This means that you can include new controllers in an available control network. An Advant Controller can run old application programs (if the functional libraries coincide).

Table 1-1 lists the major milestones in the development of AC110.

Table 1-1. Release History

Version	Description
2.0	More memory for the CPU MasterFieldbus interface Input modules with time tagging New analogue input and output modules MultiVendor Interface CI532 for: • RCOM and RCOM+ • MODBUS • Siemens 3964(R) Time synchronization on Advant Fieldbus 100, RCOM and RCOM+ Handling of time tagged events Communication including event handling with Advant Controller 400 Series on: • Advant Fieldbus 100 (AF 100) • RCOM and RCOM+
2.1	More powerful CPU RCOM on second serial interface of CPU Routing of communication telegrams from Advant Station 100 Series Engineering Station via Advant Controller 400 series and RCOM to Advant Controller 110. S800 remote I/O Externally synchronized clock New DB elements simplifying the engineering phase of Advant Controller 110 network: Every aspect of one signal from Data Set transfer at AF 100 up to event generation can be defined at one single DB element.
2.2	New CPU PM634 with build-in PROFIBUS-DP interface

1.7 Terminology

The following is a list of terms associated with AC 110 that you should be familiar with.

Term	Description
AC 110	**Advant Controller 110**
AF 100	**A**dvant **F**ieldbus **100**
AMPL	The **A**BB **M**aster **P**rogramming **L**anguage is used for application programming.
Application Program	An application program is a general concept of an assembly of program functions aimed at realizing and automating an addressed process control function.
Application (user-built)	An application is a user-implemented configuration of standard hardware and software units. It is the solution to the user's problem.
AS 100ES	**A**dvant **S**tation **100** Series **E**ngineering **S**tation
Backplane	A backplane is part of a subrack which interconnects inserted electronics *modules* with the help of a communication bus.
Base Station	The station containing the basic subrack is called base station.
Basic Subrack	The subrack housing the main CPU is called basic subrack.
Basic System	Basic system is the abstract name of a minimal composition of functional units forming a system.
Basic Unit	Basic unit is used for ordering purposes (for example, in the Price Book) as a name for the smallest unit to be ordered or a platform for further enlargement with alternatives and options.
Cabinet	The cabinet is the outer case of a piece of equipment (a packaging option), for example, Controller cabinet, I/O cabinet.
CPU, Central **P**rocessing **U**nit	A CPU is a functional unit consisting primarily of a microprocessor and memory.
Circuit Breaker	In the context of a process control system, a circuit breaker is a device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overload of current, without injury to itself.
Cold Start	Cold start resets hardware and software of a *controller* to their initial states. In case of Advant Controller 110 application software is loaded from the internal PROM to RAM of the CPU.

Term	Description
Controller	Controller is a descriptive name for Advant Controller products. A controller is an entity in which control applications are running. From the product viewpoint, a controller consists of *CPU*, communication and certain auxiliary equipment such as power supply. It also includes the functionality of process I/O (the process data communication software). It does not include process I/O hardware (and firmware as applicable). C.f., *Process station.*
Engineering Station	In the following chapters is term is used as abbreviation for Advant Station 100 Series Engineering Station
ESD	**ESD** stands for **E**lectro**S**tatic **D**ischarge.
I/O	I/O is process **I**nput or **O**utput. From the functional and geographical distribution viewpoint, process I/O is distinguished into two main categories - Central (located close to the controller) - Distributed (in the process environment).
IMS, Information **M**anagement **S**tation	An IMS is a station executing information management applications such as statistical control, production control, and so on
Initialization	Initialization sets a starting position.
LED	**L**ight **E**mitting **D**iode
Local Control, local operator	Local control is a mode of operation where responsibility is assigned to an operator/equipment located in the process environment close to the process object.
Module	A module is a hardware unit, with or without accommodated software, or a software unit. There are modules of various sizes and functionality. Examples of hardware modules: *Subrack*, *submodule carrier*, communication module, I/O module. Examples of software modules: Basic system program module in a controller, a PC element.
Multi-drop Connection	A multi-drop connection is a means of establishing a multi-drop network, i.e., a network with two endpoint *nodes*, any number of intermediate *nodes* and only a single path between any two *nodes*.
Node	A node in general: A point in a data network. A node in an application: 1. Any logically addressable unit directly connected to the plant or *control network*. Examples are controller, process station, operator station. 2. Any logically addressable unit connected via RCOM.

Term	Description
Off-line	With off-line configuration, configuration data is created outside the application for later installation, or the internal configuration data is directly affected, but the application is inactive.
On-line	With on-line configuration, the internal configuration data of a system application is directly affected, while the application is active.
Position	Position means: 1. The place in the subrack where you put a *module*. 2. The place in a *submodule carrier* where you put a submodule (submodule position).
Process Object	A process object is process concept/equipment, for example, valve, motor, conveyor, tank.
Process Station	Process station is a descriptive name for Advant products. A process station is an entity in which control applications are running. It includes the process I/O. C.f., *controller.*
RAM	**R**andom **A**ccess **M**emory
Redundancy	Redundancy in general means the existence of more than one capability of an item (system, apparatus, component) to perform its intended function.
Re(start)	Phases of the re(start) process include, for example, power-up diagnostics and node initialization. In case of Advant Controller 110 during the initialization phase a *cold start* or *warm start* is performed depending on START MODE selector of the CPUl.
Submodule Carrier	A submodule carrier is a module (circuit board) which houses smaller *modules* (submodules):
Subrack	According to IEC 916, subracks (equipment frames) are the mechanics which house rows of modules. Different types of subracks are available, for example, controller subrack, I/O subrack.
Type Circuit	Type circuit is an application-specific standard solution for process control problems in case of controller configuration. The scope of a type circuit is the data base and the PC program.
Typical Solution	A typical solution is a reusable module, which is a predefined, tested and documented set of formal configuration data intended to provide a standardized solution to a frequently recurring problem. It covers all data within the engineering system. The scope of a typical solution is drawings, documents, devices, configurating data for the distributed control system, such as data base and PC programs, operator's interface, and so on
Warm Start	In case of Advant Controller 110 the system software of the CPU restarts the application program without initializing its variables.

1.8 Product Overview

Advant Controller 110 is a modular controller for logic and regulatory control.

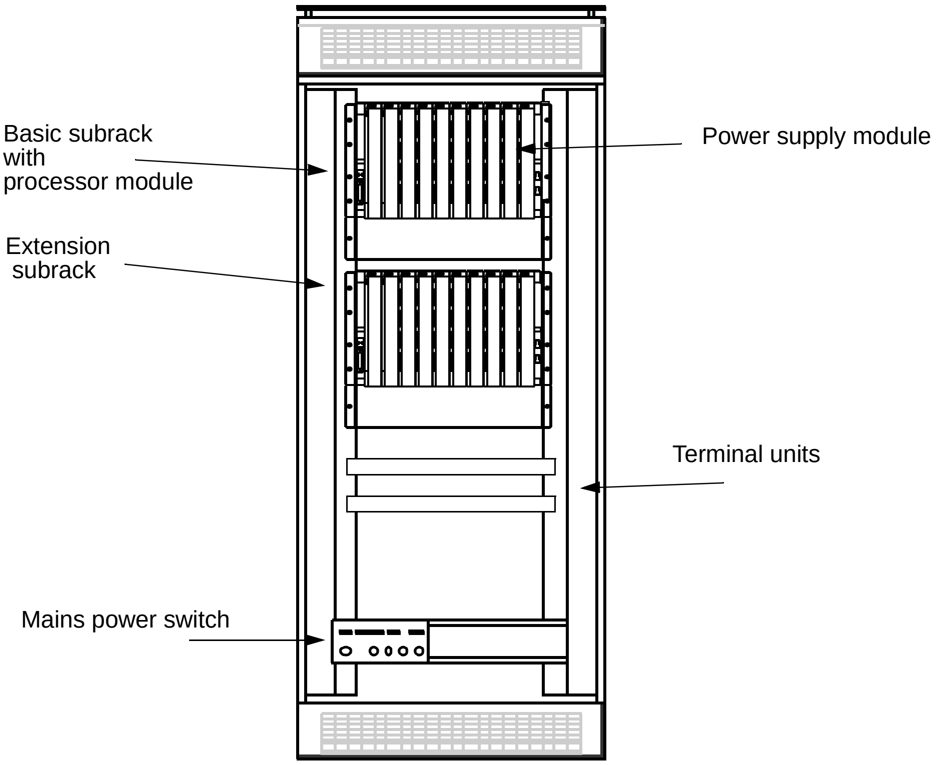


Figure 1-4. Advant Controller 110, Example of Physical Appearance

The system can handle up to 1500 inputs and outputs. Converters for d.c. motor drives can be connected via a field bus. Interfaces are available to other vendors' systems.

Measured values can be tied to event registration.

Depending on the number of input and output channels, an Advant Controller 110 system consists of one base station with one or two subracks (equipment frames) and optionally up to seven I/O stations, each with one or two subracks (see examples shown in Figure 1-5 and Figure 1-8). These stations are installed in one or several cabinets.

You can include an Advant Controller 110 in a network with products of the Advant OCS system, for example, other Advant Controllers and products from the Advant Station 100 Series (see Figure 1-1). These products include operator stations, information management systems (IMS), and engineering stations.

You can connect a local or central operator station or a local operator panel to an Advant Controller 110 (see Section 1.8.7, Operator's Interface).

The programmability of Advant Controller 110 covers a wide range of functions, such as logic and sequence control, data handling, arithmetic, and regulatory control (see Section 1.8.2.2, Functions of BASE Software and Software Options).

A function-block language with graphic representation, AMPL (ABB Master Programming Language), is used for configuration and application building. It is especially oriented toward process control (Section 1.8.6, Process Control).

Program entry, testing, documentation and fault tracing are supported by the Advant Station 100 Series Engineering Stations. These stations feature graphical Windows based function-chart programming and a user interface with multiple windows, pull down menus and "point-and-click" selection. Advant Controller 110 communicates with the engineering station through a standard serial interface. If the target node for the engineering station is a member of an Advant Fieldbus 100 network the Engineering Station is able to access all other stations on the network from that single connection. It is further possible to connect an Advant Station 100 Series Engineering Station to an Advant Controller 400 Series station and go from there with an RCOM connection to the Advant Controller 100 station.

1.8.1 Product Structure

1.8.1.1 General Modularization

Advant OCS is a totally modularized system at all levels. Seen from a high level Advant OCS consists of a family of system products. An example of an Advant OCS system applying system products is illustrated in Figure 1-1.

The functional extent of Advant Controller 110 system is determined by adding optional software and hardware units to the basic unit. The software options are delivered as program modules and may be selected to create the desired functional configuration. Optional hardware units are I/O and communication modules, and so on.

1.8.1.2 Hardware

The basic unit for an Advant Controller 110 consists of the units in accordance to Table 1-2.

Table 1-2. Basic Unit for Advant Controller 110

Units	Description
RF615	Basic subrack
RC610	Cable duct
BASE	Basic system software (including OPT2 and OPT3)

This basic unit can be used with either processor module, PM632, PM633, or PM634. You can extent the basic unit to an Advant Controller 110 system that includes:

- Processor module with CPU and memory residing the fixed internal program (the system software) and the application program. There are three different types of processor modules available: PM632, PM633, and PM634. For details see Section 1.8.2, General System Utilities.
- Process I/O modules

- Power supply module
- Communication modules
- Communication submodules
- Submodule carrier.

The process I/O is described in a separate I/O documentation (see *S600 I/O Hardware Reference Manual* and *S800 I/O Hardware User's Guide*). This means that, in this manual, you will find only short presentations of supported I/O systems and I/O modules.

Processor module, power supply module, communication modules and submodule carrier are installed in a subrack. Free slots in the subrack may be used for S600 I/O modules. Additional I/O modules can be installed in a second subrack or in separate I/O stations. Figure 1-5 shows an example of an Advant Controller 110 system structure with 2 base stations and 1 I/O station.

1.8.1.3 Software

When you order an Advant Controller 110, you select the desired function repertoire from several software options. These software options are delivered on diskettes, which can be loaded into the flash PROM of the processor module using the engineering station.

- Basic system software functions (always included):
  - BASEBasic system
  - OPT2MVI, support for SC610 and CI532
  - OPT3Event handling.
- Additional system software functions:
  - OPT1 Additional PC elements
  - OPT4MODBUS I, support for local operator station
  - OPT5RCOM/RCOM+ at second serial interface of CPU
  - EXTSystem software extension.

1.8.1.4 Example of Advant Controller 110 System Structure

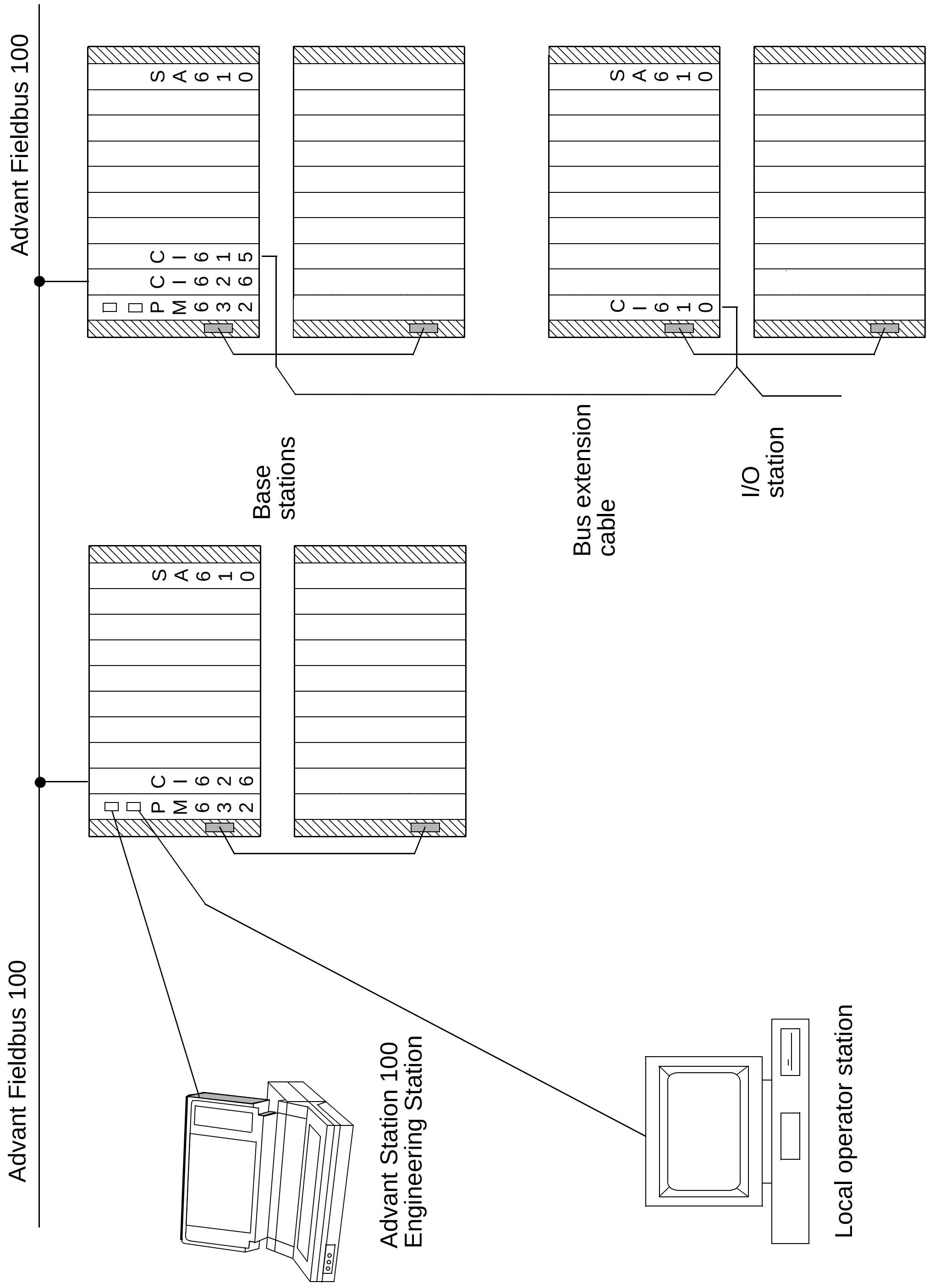


Figure 1-5. Example of Advant Controller 110 System Structure

1.8.2 General System Utilities

1.8.2.1 CPU

Following types of central processing units are offered for Advant Controller 110:

- PM632 (Motorola 68000 processor, running at 16Mhz)
- PM633 (Motorola 68340 processor, running at 25Mhz)
- PM634 (Motorola 68340 processor, running at 25Mhz), build-in PROFIBUS-DP interface.

All the central processing units include a real-time clock and calendar. Provisions are made to install an optional battery on the front of the central processing units. This serves as the standby supply for the clock and calendar circuit and for the RAM used to store variables and other application data (for a minimum of 140 days).

Indicators

On the module front of each CPU you can see indicators and a character display for high level system diagnostics. Faults are indicated on this diagnostic display and by a relay contact.
You can obtain more detailed diagnostic information by connecting the Advant Station 100 Series Engineering Station to the central processing unit.

Start-Mode

A three-position switch (PM632) or four-position rotary switch (PM633/PM634) allows the selection of the start mode. See Section 4.3.3, Start Modes for more information on these functions.

Serial Interfaces

There are two serial interfaces on each central processing unit:

- The first one is used to connect the Advant Station 100 Series Engineering Station programming, configuration and maintenance tool unit.
- The second is used for exchanging data using the Modbus I (RTU) protocol with an operator station based on a personal computer or for running the RCOM protocol (with additional software option).

Memory

The CPU modules PM632, PM633, and PM634 are supplied completely with a built-in memory. No extra memory modules are required or can be added. The system software flash PROM holds the controller system software and provides all memory executed in run time. The user flash PROM holds the controller system configuration and application program which will be loaded to the RAM at system start.

Table 1-3. CPU Memory

CPU type	RAM	User Flash PROM	System Flash PROM
PM632	512Kbyte	512Kbyte	512Kbyte
PM633	1Mbyte	1Mbyte	1Mbyte
PM634	1Mbyte	1Mbyte	1Mbyte

1.8.2.2 Functions of BASE Software and Software Options

Base Software, BASE SW*2.2

The Advant Controller 110 Base software includes a real-time operating system, a PC element library, diagnostic functions and interfaces for the Advant Station 100 Series Engineering Station and AdvaSoft for Windows.

The application program consists of one AMPL program, i.e. one PCPGM, and up to 31 subordinate execution units (CONTRM, SEQ or MASTER). These are executed cyclically with execution times selectable from 2 ms to 20 s. It is also possible to define subordinated execution units (CONTRM) that are executed once at cold start or warm start. The start-up sequence can be defined by the user.

Diagnostic functions monitor system operation and report any faults detected. The monitoring functions include a watchdog, bus supervision and memory checking. Faults are indicated on the diagnostic display on the front of the unit. More detailed diagnostic information can be obtained with an Advant Station 100 Series Engineering Station.

Communication functions via Advant Fieldbus 100 and MasterFieldbus are included.

The basic system program is sufficient when you need digital signal processing, arithmetic, queue and shift functions. It works with both analog and digital input and output signals.

The basic program module has a functional contents in accordance with:

- Logic control and time delays
- Arithmetic
- Sequence control
- Calendar time functions
- Advant Fieldbus 100 communication
- Communication via RCOM/RCOM+
- Event handling and transfer of events to Advant Controller 400 Series
- CPU load measurement
- MasterFieldbus communication.

Most of the above mentioned functions are realized with one or several AMPL elements. The contents of the PC element library in the basic program module is shown in Table 1-4

*Table 1-4. PC Elements of the BASE System Software BASE SW *2.2*

Type	Function	PC element
Structure	Structuring the PC program and sequential control	PCPGM, CONTRM, FUNCM, MASTER, SLAVEM, BLOCK, SEQ, STEP
Logic	Combinational logic and Boolean memory	AND, OR, XOR, INV, TRESH-L, SR, SR-D, SR-AA, SR-AO, SR-OA, SR-OO, AND-O, OR-A, BGET, BSET
Time	Timer for on- and off-delays, pulse functions, oscillator and calendar timing	MONO, TON, TOFF, TON-RET, TRIGG, AND-TRG, OR-TRG, OSC-B, TIMER, SYSTIME
Register	Shift and queue register	FIFO, MOVE, REG, SHIFT
Switches	Switching sets of data	SW, SW-C
Multiplexer	Select data from a group of data	MUX-I, MUX-MI, MUX-MN
Code converter	Convert data from one type to another, for example, Boolean to integer	CONV, CONV-BI, CONV-IB
Counter	Pulse counting	COUNT
Arithmetic	Basic arithmetic operations and square root, absolute value and limit functions	ADD, SUB, MUL, DIV, ABS, SQRT, LIM-N, DIV-MR, MULDIV
Comparators	Comparison of two numbers, limit value monitoring and maximum or minimum selection	COMP-I, COMP-R, COMP-B, MAX, MIN
Miscellaneous	Communication with MasterPiece 200/1 and Advant Controller 400 series via MasterFieldbus Communication with slave nodes of type TYRAK-L via MasterFieldbus Evaluate the load of an Advant Controller 110 system	MFB-IN, MFB-OUT COM-CVI1, COM-CVO1 SYSL

Software Option 1, OPT1 SW*2.2

The software option 1 extends the PC element library that is included in the basic program module with PC elements for supporting the functions listed below:

- Regulatory control.

The function above is realized with PC elements. The contents of PC elements in OPT1 are shown in the following table.

Table 1-5. PC Elements of the Option OPT1

Type	Function	PC element
Function generator	Generates an output from an input variable according to a function described by a group data table.	FUNG-1V
Filter	Single-pole low-pass filter.	FILT-1P
Feedback control	Various conventional P, I, and D functions and combinations thereof, a pulsed regulator and a ramp generator.	P-1, INT, DER, PI, PIP, PDP, CON-PU1, RAMP
Register	Register for assembling single data with a group data.	REG-G

Software Option 2, OPT2 SW*2.2

In conjunction with the MVI module CI532 V01, V0,2 or V03 the software option 2 (MVI Handling) extends the functionality of the controller with the following communication facilities.

- RCOM/RCOM+
- Siemens 3964(R)
- MODBUS.

Software Option 3, OPT3 SW*2.2

The software option 3 (Event Handling) extends the functionality of the controller with event handling in accordance with the following:

- Detection of events from digital or analog output terminals (calculated events)
- Handling of events from modules DI650
- Event handling and event transfer via AF 100
- Event handling via RCOM/RCOM+ (requires also OPT2 software)
- Time tagging of events
- Transit of events.

Software Option 4, OPT4 SW*2.2

The Optional program module OPT4, Modbus I extends the functionality of the controller with the MODBUS I protocol (RTU, binary mode), which is intended for communication with an IBM PC based MMI package. Advant Controller 110 can be used **only as a slave** with the fixed address 1 on MODBUS.
The separate serial interface (CH2 connector) on the processor modules is used for this purpose.

Software Option 5, OPT5 SW*2.2

The optional program module OPT5, RCOM Driver enables the processor module to communicate via the RCOM/RCOM+ protocol using the processor module’s separate serial interface (CH2 connector). A separate MVI module is not needed.
Either option OPT4 or OPT5 can be used but not both simultaneously.

System Software Extension, EXT SW*2.2

With this option you can write your own AMPL PC elements.

A dedicated diskette includes all necessary items as extension loader, interface library and a detailed descriptive manual to create and load application specific AMPL elements in addition to the Advant Controller 110 system software. Commercially available tools as compiler, linker, loader and assembler must be purchased separately.

1.8.2.3 System Clock, External Clock Synchronization

The Processor Modules PM632, PM633 and PM634 are provided with a calendar clock that is backed up by the same battery used for memory backup. You can set the date and time from Advant Station 100 Series Engineering Station or from AdvaSoft for Windows.

With Advant Controller 110 connected to AF 100, as a part in a distributed control system, the synchronization occurs automatically with other stations via a network. One station of the AF 100 network is time synchronization master sending the time to all other stations.

The processor modules PM633 and PM634 can be synchronized by an external clock (minute pulse) which can be directly connected to these modules.

1.8.2.4 Configuration

You configure the system in accordance with the hardware and software selected, for example, the number of I/O modules, communication lines, and PC programs. This is performed using a configuration tool such as the Advant Station 100 Series Engineering Station.

1.8.2.5 Execution

The system software (operating system and PC interpreter) organizes the execution of the units of the application program with the periodicity selected, simultaneously performing other tasks such as communication with programming tools or with other AC 110 controller stations using AF 100 or other protocols (see also Section 1.8.2.2, Functions of BASE Software and Software Options).

1.8.3 Power Supply

The Advant Controller 110 with S600 I/O can be connected to the following types of primary supply:

- 120V or 230V a.c., 47 to 450 Hz, using the power supply module SA610.
- 110V/125V or 220V/250V d.c., using the power supply module SA610.
- 24V d.c. filtered voltage, direct supply to the I/O station from an external power supply. The acceptable voltage range is 19.2...30 V d.c.
  SA 160 or SA 161 can be used as an external power supply.

The use of the power supply module SA610 is recommended. SA610 is housed in the standard module enclosure and occupies one position in the subrack.

SA610 is capable of powering a typical I/O station consisting of one or two subracks. When one SA610 is not sufficient, two can be used in parallel.

In addition, you can find more detailed hardware descriptions of SA610 in the *S600 I/O Hardware Reference Manual.*

1.8.4 Process Interface

1.8.4.1 S600 I/O

The I/O system of Advant Controller, S600 I/O is used as **local I/O** system close to the controller, in the controller subrack or cabinet.

A range of I/O modules is available, covering analog and digital signals of various types. In addition, there are modules for temperature measurement, pulse counting and position measurement applications. The process signals are connected to the front of the I/O modules.

The S600 I/O is modular and may consist of up to 75 I/O modules. The maximum number of I/O signals for an Advant Controller 110 is 1500.

I/O modules may be exchanged during system operation. The process signals are disconnected by removing the front connector. A newly inserted module is automatically put into operation if the system identifies the module as being of the correct type and without faults. I/O stations may be added to further extend the number of I/O modules connected to the system.

The S600 I/O Hardware Reference Manual details the various S600 I/O units available for Advant Controller 110.

1.8.4.2 S800 I/O

For applications requiring the use of **remote I/O**, the full range of S800 I/O modules may be connected over Advant Fieldbus 100. These modules cover analog and digital signals of various types.

The S800 I/O Hardware User's Guide gives details about these modules.

1.8.5 Communication

Various buses and links in accordance with Table 1-6 can be connected to Advant Controller 110.

Table 1-6. Number of Buses and Links Connectable to Advant Controller 110

Bus/Link Type	Max number
Advant Fieldbus 100	max. 2 buses
MasterFieldbus (slave function)	max. 4 buses
MasterFieldbus (master function)	max. 4 buses

Table 1-6. Number of Buses and Links Connectable to Advant Controller 110

Bus/Link Type	Max number	
Bus extension to S600 I/O	max. 1 bus	
PROFIBUS-DP via build-in interface in PM634	max. 1 bus	
RCOM via second serial interface at processor module	max. 1 link(1)	Total max. 1
MODBUS (slave function) via second serial interface at processor module	max. 1 link(2)	
RCOM via submodule CI532	max. 4 links(1)	Total max. 4
MODBUS via submodule CI532	max. 4 links(2)	
SIEMENS 3964R via submodule CI532	max. 4 links	

(1) You can install RCOM in various ways. That means when using communication interface modules CI532 and serial interface at processor module you can install up to max. 5 links for RCOM.

(2) You can install MODBUS in various ways. That means when using communication interface modules CI532 and serial interface at processor module you can install up to max. 5 links for MODBUS.

1.8.6 Process Control

1.8.6.1 Programming Language

Process control applications are programmed in the ABB Master Programming Language (AMPL), a function-block language with graphic representation which has been developed especially for process control applications.

The language is characterized in this way: each function is seen as a building block with inputs and outputs. The function of such a block can be simple, such as a logic AND function, or complex, such as a complete PI regulator. A program written in AMPL is referred to as a PC (process control) program, and the building blocks are called PC elements.
The range of ready-to-use function blocks is wide and powerful.

The smallest units in the language are standardized functions, represented by graphic symbols (PC elements). Each PC element represents a complete function such as an AND-gate, a time delay, a shift register, a PI function, and so on (see Figure 1-6). The language offers a simple method to link PC elements and describe the data exchange between the functions selected to control the process.

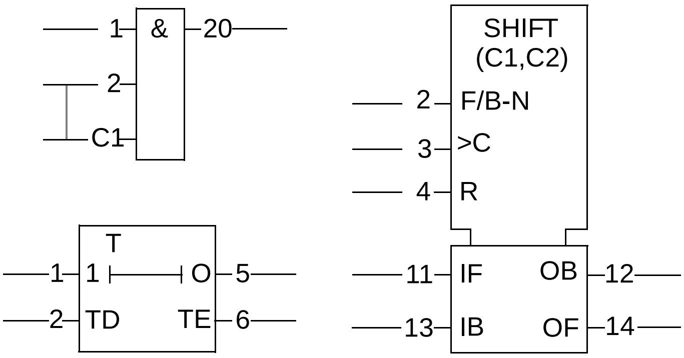


Figure 1-6. Example of PC Elements (AND, TON, SHIFT)

You can assemble a number of PC elements to form a PC module, which in turn can be incorporated in further modules. Several modules form a PC program, which is the solution to automate an addressed process control function. Such a PC program executes the PC modules, element by element, with a cyclicity which you can select from 2 ms up to 20 s.

Data base elements (DB elements) are used for exchanging data with the I/O-system and with other parts of the Advant OCS system.
For information about AMPL, see *AMPL Configuration Advant Controller 100 Series Reference Manual.*

1.8.6.2 On-line Features

The Advant Controller 110 provides a wide range of on-line features:

- On-line configuration and programming:
  On-line configuration and programming is the modification of a user application program on an engineering station while the engineering station is connected to an Advant Controller 110 system. Modification in this case includes insertion and deletion of executable units or DB elements. The modification of an running application program is bumpless and remains after disconnecting the engineering station.
- Value display and value forcing:
  Value display (monitoring) and forcing of PC terminals are parts of the test functions of the engineering station. During display or forcing of values the engineering station has to be connected to an Advant Controller 110 system. The Advant Controller 100 system will stop forcing after disconnecting the engineering station.

For more information see *AMPL Configuration Advant Controller 100 Series Reference Manual.*

1.8.7 Operator's Interface

Advant Controller 110 offers a range of different interfaces to operators. A short presentation is given below. For detailed information, see separate documentation.

1.8.7.1 Maintenance Personnel

The main purpose of this type of interface is to support fault tracing and backup handling of an application program. There are:

- Start mode selector, LED indicators and character display on the processor module
- Diagnostics LED indicators on most hardware modules
- Advant Station 100 Series Engineering Station provides menus for error report and module diagnostic.

1.8.7.2 Local Operator

Panel

Panel units, for example, numeric display, keyboard, function keyboard, push button, and thumbwheel connected via Modbus I protocol at second serial interface of processor module PM632, PM633, or PM634.

Local Operator's Station

You can connect a personal-computer-based operator station to Advant Controller 110 via Modbus I protocol at second serial interface of processor module PM632, PM633, or PM634.

1.8.7.3 Central Operator

You can use AdvaSoft for Windows for a PC-based central operator station for Advant Controller 110 systems.
Advant Controller 110 stations are connected via Advant Fieldbus to AdvaSoft for Windows.The figure below shows an example of an Advant Fieldbus 100 (AF100) configuration several Advant Controller 110 stations.

For information about AF100, see *Advant Fieldbus 100, User's Guide*.
For information about AdvaSoft, see *AdvaSoft for Windows, User's Guide.*

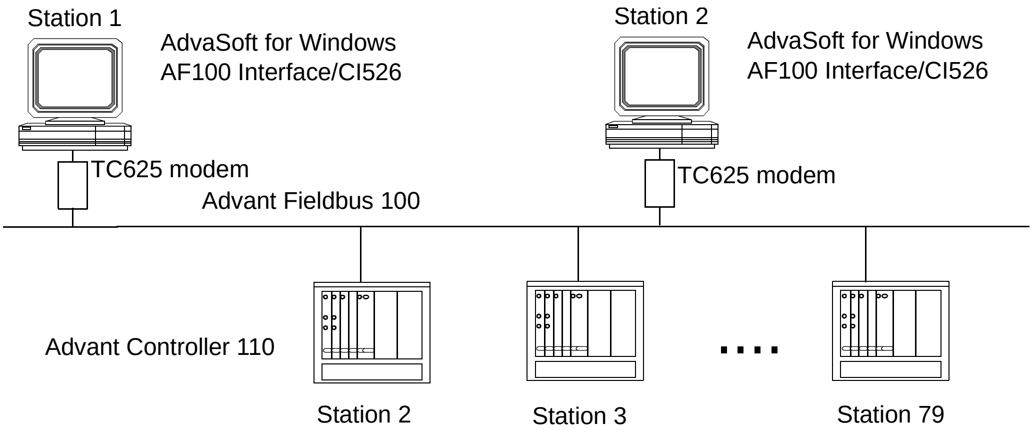


Figure 1-7. Advant Fieldbus 100 Interface in ABB Automation System

1.8.8 Mechanics

Mechanically Advant Controller 110 consists of subracks, cable ducts, modules and process connectors. The subracks and cable duct are designed for wall mounting.

For more information see Section 2.2.14, S600 I/O. Figure 1-8 shows the physical layout of a basic and extension subrack.

Advant Controller 110 can be delivered as separate subracks for mounting in any suitable cabinet too. It can also be delivered in standard cabinets.

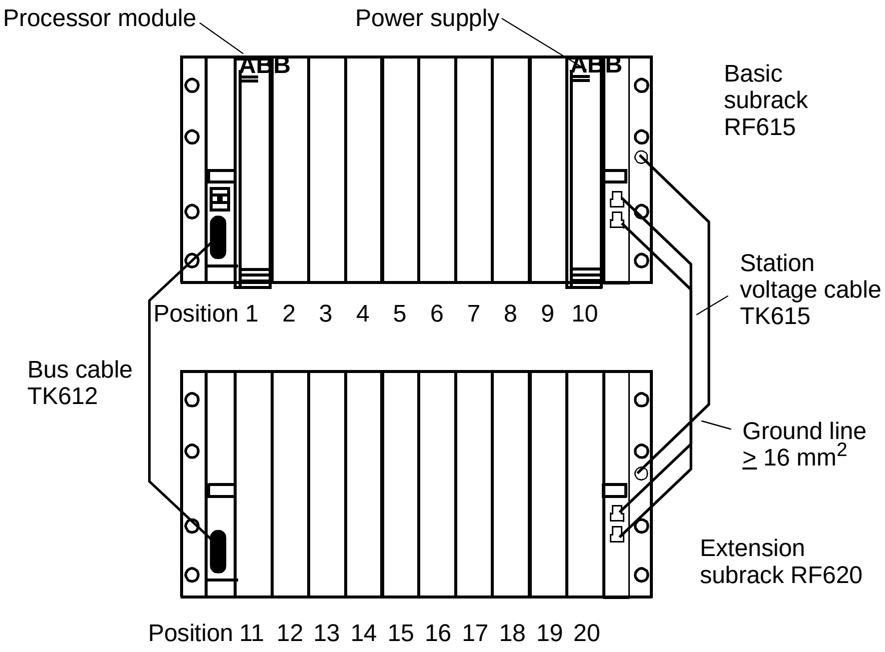


Figure 1-8. Example of Advant Controller 110 Base Station

Chapter 2 Installation

This chapter contains guidelines for planning the installation of your Advant Controller system, see Section 2.1, Site Planning. In addition, this chapter also describes the concrete installation procedures on site, specific to Advant Controller 110, see Section 2.2, Installation Procedures.

This chapter does not, however, provide a complete list of measures to take with respect to environment and other conditions on site. The equipment should be adapted to the actual application by way of thoroughly accomplished system definition, ordering, and design.
You can find descriptions of alternative solutions, design considerations, and so on, elsewhere in this manual.

Since each Advant Controller system is designed to meet your specific requirements, there is no standard configuration that describes every system. Therefore, certain areas of the following instructions are meant only as a guide for planning your specific installation. However, some of the information covers specific requirements for proper system and equipment operation —you cannot modify these requirements. The difference between a recommendation and a requirement is clearly defined as necessary.

Installation of options is often described in dedicated user’s guides. For information about available documents corresponding to desired options, see Section 1.5, Related Documentation.

All information given in this chapter relates to standardized models. Where alternatives exist, a typical alternative is described.

2.1 Site Planning

2.1.1 Site Selection and Building Requirements

When you are planning a control system installation, consider the following points, among others:

- The surrounding environment and atmosphere
- The temperature in the room where the equipment is to be located.
  This includes an estimate of the resulting temperature rise with respect to the power dissipation from the planned equipment.
- The proximity of the control room to the process
- The size and shape of the control room which is to accommodate all the required equipment
- The lighting for a control room, which should be powered by a power source independent of the system equipment.
  A battery-powered emergency lighting system is recommended.
- The minimum distances from a cabinet to walls and ceiling required to obtain satisfactory results from different areas
- The weight of the equipment and the corresponding requirements of the floor construction

- Ease of access for moving equipment in and out of the control room.
- Space, suitably furnished for maintenance
- The free space in front of cabinets.
  Also reflect on how much space is required to fully open either a left-hand or right-hand hinged cabinet door (both exist). There must always be space left for safety reasons even with open doors.
- Spare area for future enlargement of the equipment
- A well-developed process connection, with or without marshalling facilities
- Grounding by an effective net of copper bars
- Cable routing with respect to installation rules
- Availability of power and other utilities
- Standards and legal regulations to be followed.

The following sections examine some of these factors in detail and provide recommendations and requirements as necessary.

2.1.2 Environmental Considerations

General

The Advant Controller system is designed for a demanding industrial environment. Alternative cabinetry is available for different degrees of protective rating (IP21, IP41, IP54). Interference from electrical sources is suppressed by a suitable solid design and particular installation rules. Equipment is to be located in a control room or an electric room or distributed in the process area.

The common requirements for the building where the system is to be stored or installed are:

NOTE

> The building should provide an environment such that established environmental conditions are not normally exceeded.

The environmental conditions which Advant OCS products are designed to withstand, during storage and transport as well as during operation, are specified in a separate environmental data sheet. Limit values are given to: Corrosive gases, Temperature, Vibration, Moisture, Electro-Magnetic Compatibility, and so on.

Most applications need no special arrangement. Standard cabinetry and installation according to the rules suffice. Occasionally, you must consider special protection with respect to particular situations.

Sealed cabinets are a good basic solution to prevent damage to electronic equipment from, for example, corrosive gases, moisture, and dust. However, sealing prevents the normal cooling resulting from self-convection or forced cooling by a fan. In turn, this reduces, to a large extent, the heat dissipation permitted in a cabinet.

Some alternatives, in addition to those offered by other standard cabinets, follow:

- Sealed cabinet pressurized by clean, dehydrated instrument air
- Gas cleaning by chemical filter
- Use of dehydrated air
- Dust filter
- Sealed cabinet cooled by a heat exchanger.
  It is reasonable to assume that a heat exchanger may be inoperative for short periods. Under these conditions, the temperature in a cabinet must not exceed 70°C.

For further information about the environmental immunity, refer to the data sheet *ABB Master Environmental Immunity.*

Temperature

It is important to note the temperature within cabinets and in the surrounding environment and atmosphere. Lower temperatures mean increased system reliability and availability.

The lives of wet, electrolytic capacitors and most semiconductors are greatly reduced if the maximum permitted temperatures are exceeded.

For more information on design considerations, see Section 3.1.8.2, Heat Dissipation Permitted in Cabinets.

Vibration

The cabinets must stand on a stable floor, deck, or supporting structure, free from vibrations.

If the system equipment is installed in a control room adjacent to large machinery such as shakers or large presses, where frequent major vibrations occur, shock absorbers or an isolation pad may be required to protect the system equipment. Shock absorbers normally protect the equipment from sustained low-level vibrations (vibrations that are perceptible, but not excessive). If vibrations or shock are a major problem, consider more extreme measures to alleviate the problem.

2.1.3 Electromagnetic Compatibility

Interference-free operation requires well-considered planning and realization of the installation, especially with respect to grounding, cable selection and cable routing. Some notes are given in the following sections from a planning viewpoint, while the setup instructions give you detailed information about the actual realization of the installation.

For more information, both theoretical and practical, on the subject of Electromagnetic Compatibility including interference, interference sources, and suppression measures, see separate reference documents.

You can obtain CE-marking according to EMC Directive 89/336/EEC for your Advant Controller 110 provided appropriate cabinetry is selected. Refer to the ordering documentation.

2.1.3.1 Summary of CE-marking Aspects

CE-marking of the Advant OCS products implies some minor but important changes of the design with respect to cabinetry, mains supply filtering and handling of cable shields at the enclosure port. All to ensure conformity to the EMC-Directive 89/336/EEC.

The following is a summary of the most important changes.

Cabinetry

According to information given in the ordering documentation, Advant Controller 110 shall be located in a radio-proof cabinetry. Note that the requirement is valid to controller cabinet, I/O cabinet, and terminal unit cabinet, if separated.

Standard cabinet RM500 is available in radio proof configurations
for protection class IP 21, IP 41, and IP 54.

Open compartment is not permitted for any part of the controller and its I/O including the terminal units.

Immunity against electromagnetic fields can generally be guaranteed with the cabinet containing metallic doors only.

Erection of Cabinets

Advant OCS mounted in a RM500, can be set up side by side with other cabinet types and other equipment types, but the cabinet side plates must be ordered or not be removed if included at the delivery.

Where several electronics cabinets of the same type, related to one controller with S600 I/O, are to be set up in the same row, however, it is permissible to leave out or remove the side plates between the cabinets.

Mains Net Filter

Protection against line conducted radio emissions is obtained by means of a special filter placed in the bottom of the cabinet on the incoming supply. One filter for each supply is utilized.

Cable Shields

Cable shields which are to be directly grounded in the cabinet must be **additionally** grounded close to their entrance in the cabinet. The cable sealing at the bottom plate is used.

Shielded cables which are not directly grounded in the cabinet are to be connected via a capacitive decoupling device, located in the bottom of the cabinet.

2.1.4 Standard Layout and Disposition of Cabinets

A series of rules for mounting the controller and I/O in RM500 cabinets follows. These configuration rules are applied when the customer has no preconceived ideas regarding the design. This is the standard solution, which is important to know when you are planning a control system. The complete list of rules are presented in ordering documentation (see also Appendix C, Cabinet Configuration).

General

- All cabinets (single or double) sharing the same bus extension for S600 I/O (maximum 20 m) are connected to the same power switch.
- An Advant Controller 110 with I/O is delivered in a number of single or double cabinets.
- Up to five cabinets, each with two subracks can be connected to the same electrical bus extension.
- You can add an extra, seventh cabinet if necessary to house terminal units. This cabinet is placed to the right and cannot contain an I/O subrack. Cables with extended length have to be used from the I/O subracks.
- An I/O subrack is not filled with more than 18 modules, two empty positions are kept as spares for the future.
- In each double (single) cabinet, space for one mounting bar (for terminal units) is left unused.
- The modules are placed in the I/O subracks in the order AI, AO, DO, DI starting in subrack No. 1.

Location of S600 I/O Cabinets

The configuration of cabinets is illustrated in Figure 2-1.

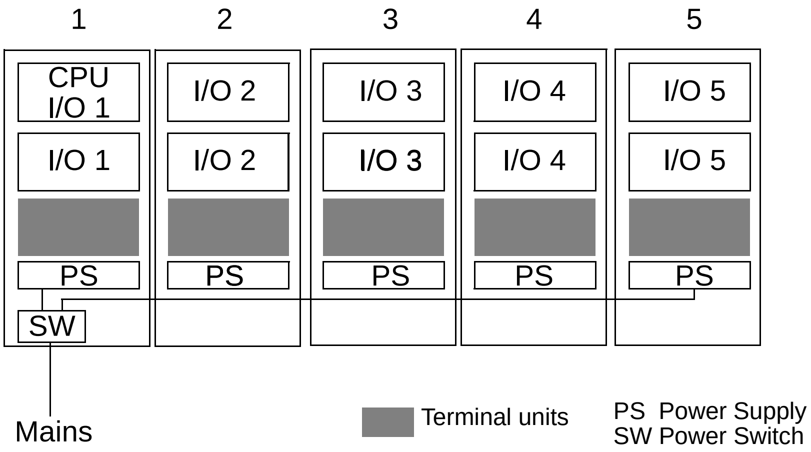


Figure 2-1. Standard Cabinet Configuration (Maximum)

- Normal start configuration is a single cabinet.
- With the controller cabinet to the left, the building direction is to the right.
- One set of power supplies for field equipment, if included, is placed in cabinet No 2.
- Connection units are placed only within the same double (single) cabinet that houses the corresponding I/O subrack.

2.1.5 Grounding

Grounding in General

The signal processing electronics in Advant OCS, as well as all interference suppression for external signals, are normally directly grounded to chassis and plant earth.

The plant earth potential must be stable and well defined, even in the event of ground fault in low- and high-voltage equipment or lightning strike. This claim for a grounding system is common to the high-voltage equipment. The earth line joining the grounding systems should be ≥35 mm^2 Cu.

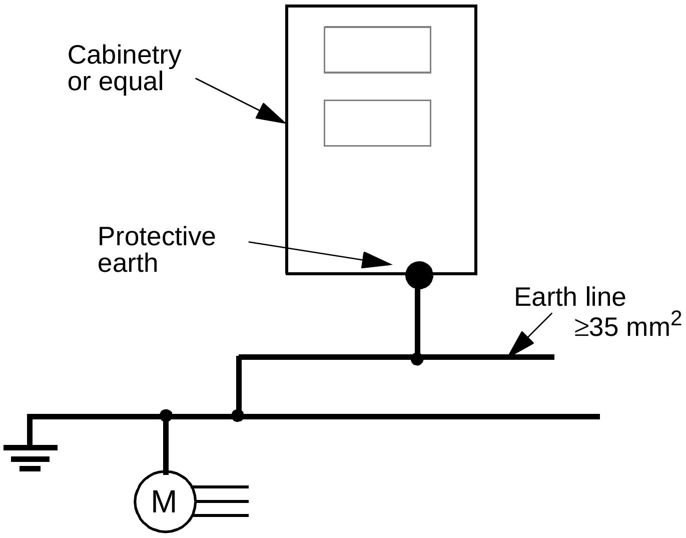


Figure 2-2. Grounding of Electronic Equipment

Protective Earth

Always provide Advant OCS cabinets supplied with 230 V a.c. with a protective earth.

Grounding of Signals and Voltage Supply

For minimum interference and maximum accuracy, it is normally most effective to ground the signals from transducers directly in the grounding bar in the Advant Controller. For freedom from interference, it is also advantageous to ground supply voltages for transducers, sensing voltage for contacts, load supply voltage, and so on.

You may have to deviate from these two basic rules in order to adapt to other requirements such as measurement techniques or safety regulations. In such cases, you must ensure that, for example, differential inputs for analog input signals are used or that digital inputs and outputs are divided into groups in the terminal unit, with the possibility of supply voltage distribution and earthing in other equipment.

A consequence of requiring local grounding of a signal at the transducer location may be a requirement for a completely individual voltage supply to each transducer. In such cases, you can use a bar with the terminal block and fuse equipment required by the application.

If the transducer has galvanic isolation of the supply from the electronics otherwise, you can ground its signal zero freely and where it is most suitable for measurement accuracy without special voltage supply requirements such as group division, fusing, and grounding.

2.1.6 Cables

When you are planning for the cable routing in the plant and selecting suitable cables to use, there are some restrictions and rules to follow. These touch upon, among other things:

- Distance between Advant OCS cables and non-Advant OCS cables
- Routing of communication cables
- Mixing of signals and signal types within cables
- Need for shielded cables.

For further information, refer to the general document, *Interference-free Electronics Design and Applications*, which also gives examples for choosing cables.

All cables are normally guided into a cabinet from below.

2.1.7 Power Supply and Fusing

General

Normally, supply voltage to Advant OCS supply units and for field equipment can be obtained from the plant a.c. or d.c. supply.

A summary of the main requirements of the supply from a planning viewpoint follows.
Primarily an A, B, and C network should be available as applicable.
Supply A and B refer to redundant networks.
Supply C is feeding modems which use a.c. power supply. In the tropical cabinet version the heating element is also included.
Supply C is always an a.c. supply, regardless of whether a.c. or d.c. is utilized otherwise.
Preferably supply C should be an uninterruptable power supply. In situations where redundant network A/B is used you can order a power distribution unit, SV542/543, which includes a selector relay and an isolation transformer. The relay selects between, for example, network A and B and the transformer makes a secondary grounding of the network possible (adaption class III/class II).
Class II, class III states the network quality with respect to, for example, level of disturbances, voltage variations, and so on (according to IEC standards). Class II denotes higher quality than class III.

You can use power supply units made by other vendors for, for example, sensor supply, and locate those units in an I/O cabinet. Such units must satisfy interference requirements in accordance with the relevant standards in the same test classes as the Advant OCS equipment and they must be CE-marked if equipment is going to be used within the EU and EFTA area.

Safety Switch

Close to the controller installation, there should be a safety switch enabling **total** power supply disconnection of the equipment. This means a common switch for all supply voltages, for example, networks A, B, and C discussed above.

The main use of the safety switch is to disconnect the power supply in a clear and safe way during work in the cabinet.

Install the safety switch in a visible place (outside any cabinetry) within 3 m of the controller installation.

a.c. Supply

Essential information includes:

- For the supply A (and redundant B) class II or class III a.c. networks can be used alternatively as a standard solution.
- For the supply C there are different options. Select a suitable power distribution unit with respect to available class II and class III networks and your requirement on redundancy.
- Single and return (class II), as well as two-phase (class III) connection, of a standard controller are possible.

d.c. Supply

Essential information includes:

- When using a d.c. supply, only battery-supplied systems with a non-grounded battery can be used for direct supply of Advant OCS. With this type of supply, the battery is grounded in the Advant OCS equipment.
- Supply from a grounded battery requires an isolating d.c./d.c. convertor.
- Supply C is always an a.c. supply, see heading above.

Protective Earth

Always provide Advant OCS cabinets supplied with 230 V a.c. with a protective earth.

Current Consumption and Fusing

See Section 3.1.3, Power Supply for instructions for making current consumption calculations and for dimensional rules for distribution board fusing. In addition, a quick guide to the power consumption to use whenever you need estimated figures is also located in this section.

Uninterrupted Power Supply

In certain applications, you must guard against brief voltage failures by using an uninterruptable supply. See Section 3.1.3, Power Supply for important considerations in doing so.

2.1.8 Process Connection

There are two ways to connect process signal cables:

- Connection directly to the S600 I/O process connector with screw terminals.
- Connection to terminal units (TX650).

Connections between I/O modules and the associated terminals units (TX650) are made with prefabricated ribbon or multi-core cables using a S600 I/O process connector with crimp terminals. The cables are available in the price list in several standard lengths (3 m, 5 m, 10 m). Other lengths up to 15 m (50 ft.) can be ordered separately.

The terminal units allow marshalling of the process signals.

There are certain restrictions regarding:

- Internal cable routing
- Signal earthing
- Shield earthing
- Earthing of mounting bars, cable channels
- An open compartment is not CE-marked.

For further information:

- On using ABB standard cabinets, see adequate sections in this installation chapter and the referred document below for further details if necessary.
- On using non-ABB cabinets, see *Advant OCS Installation Rules User's Guide* for compliance with the EMC requirements or the general document *Interference-free Electronics Design and Applications*.

2.1.8.1 Connection Principles, Fusing, and Voltage Distribution

There are several ways for marshalling:

- Marshalling at the terminal units.
  This is possible when the process cables are connected to terminal units. Connections between I/O modules and the associated terminals units are made with prefabricated cables using a S600 I/O process connector with crimp terminals.
- Marshalling at the S600 I/O process connector.
  This is possible when the process cables are directly or via terminal units connected to the S600 I/O process connector with screw terminals.
- Marshalling at the S600 I/O process and at the terminal units.
  This is possible when the process cables are connected to terminal units. Connections between I/O modules and the associated terminals units are made with non-prefabricated cables fitted to a S600 I/O process connector with screw terminals.

Examples of different solutions include standard installation of the terminal units in the controller cabinet or in the terminal cabinet or installation in open compartments adjacent to the controller system. However an open compartment is not a CE-marked design.

In addition to terminals for connecting signals, the S600 I/O modules process connector contain terminals for supply distribution and fuses.

To optimize function, price, and space requirements groups of signals are formed, for example a common fuse for a group of several digital inputs (example DI635, DI636). Refer to *S600 I/O Reference Manual* for further examples.The *S600 I/O Reference Manual* shows the amount of signals of the S600 I/O modules sharing the same power supply.

If fusing of individual supply is required it can be arranged with DIN terminal bars.

You can use a DIN terminal bar with connection terminal blocks and fuses for a particular application.

Consider such an alternative at an early stage in the design to ensure that it is located in the cabinet to give optimum cable lengths.

2.1.9 Hazardous Applications

Always combine standard process I/O modules with barriers for ex-environment in an application-adapted way. You may use any of the available barriers on the market which meet your requirements.

2.1.10 High Voltage Switch-gear Applications

Normally, Advant OCS equipment is not designed for direct connection to high-voltage switch-gear.

You use intermediate relays for digital input and output signals as a connecting link. For analog signals, use special measured value converters tested in accordance with relevant standards.

2.1.11 Lightning Strike Protection

Industrial installations and power plants are normally provided with well-integrated grounding nets installed together with the power distribution system. In installations with such grounding systems, it is not necessary to install lightning strike protection unless you are using overhead wiring or suspended cables outdoors.

Large dispersed plants (water supply installations, refineries, and so on) can, however, have an inadequate grounding system and signal cables can be routed above ground. In such cases, lightning strike protection must be used.

Cables outside the grounding system (even for short distances such as 10 m) always require lightning strike protection.

For installation rules, see the general document *Interference-free Electronics Design and Applications.*

2.1.12 Weight and Mounting Dimensions

When placing a control cabinet, you must provide a number of minimum distances from the cabinet to walls and the ceiling in order to ensure satisfactory results. These minimum distances are indicated below.

When cabinets are located next to each other, you can omit from the cabinets the wall cladding on the sides in contact, except from a cabinet which contains equipment which generates any degree of interference (for example, electromagnetic relays with no interference suppression). Consider this when you are ordering the equipment.

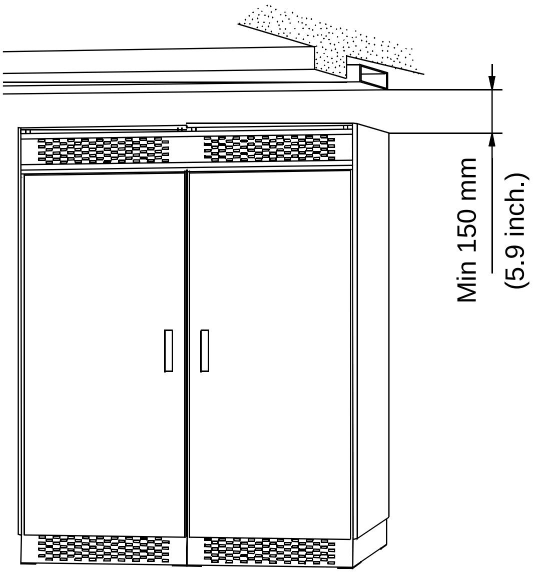


Figure 2-3. Minimum Distance to Ceiling

To ensure adequate ventilation, there should be a free space, 150 mm high, between the top of the cabinet and the ceiling or the underside of any beam, duct, or similar structure over the cabinet. When cables enter the cabinet from above, the space available should be at least 1000 mm high to provide working space.

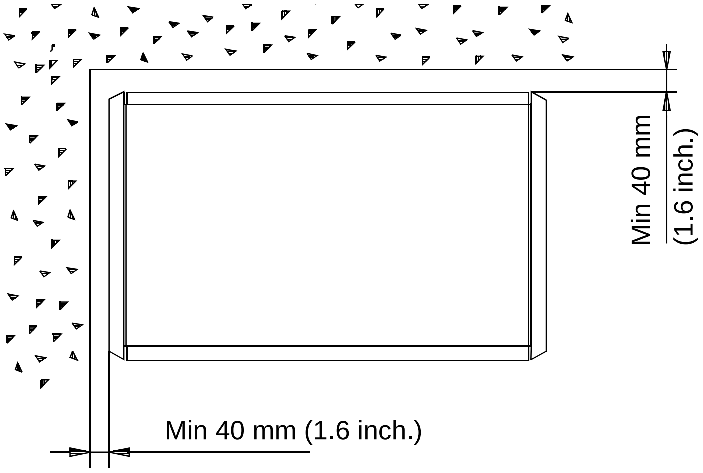


Figure 2-4. Minimum Distance from Rear of Cabinet to a Wall

The distance between the rear and the sides of the cabinet and an adjacent wall should be no less than 40 mm. This also ensures good ventilation.

The free space in front of the cabinet should be the width of the door plus the width of the aisle.

If a double door alternative is used, reflect the space required for any hinged frame. There must always be space left for safety reasons even with open doors or frames bent outwards.

For dimensions of the RM500 cabinets, see Section 3.2.9, Mechanics. You can also find the estimated weight of a cabinet in that section.

2.1.13 Transportation and Storing

Cabinets are packed in a manner appropriate to the means of transport. A pallet is commonly used, so a fork-lift truck or a hand truck is usually the most suitable means of transport on site.

Cabinets are fitted with lifting eyes to facilitate transport with a crane.

NOTE

Observe lifting instructions enclosed with the cabinet!

Store cabinets in a dry place, protected against dust.

2.2 Installation Procedures

The goal of this section is to tell you "how to" install and set up the product.
Follow the sequence of activities prior to power-up described below.
It is assumed that the equipment is assembled and delivered in type RM500 cabinets.

The equipment to be set up is ordered for and adapted to a specific application.

Apply the installation procedures with respect to the specific design!

See Section 2.2.1, Safety Regulations through Section 2.2.9, Radio-Proof Cabinet for general information, followed by individual setup descriptions for different parts of the automation system. You can find this information under the following headings, if relevant:

- Assembly
- Electric Installation (including Power Supply)
- Functional Measures
- Preparation for Start-up.

Ordinary installation drawings, terminal diagram forms, and connection documents for site preparation and installation of electrical equipment also apply.

Necessary Outfit

The following kit is a minimum requirement:

- Ordinary hand tools
- Universal instrument, for example, digital multimeter
- Test leads with 4 mm banana contacts and reducer contacts for a 2 mm test jack
- Necessary parts of the documentation listed in Section 1.5, Related Documentation
- Specific documentation enclosed at delivery, drawings, and so on.

2.2.1 Safety Regulations

Always follow the instructions below when installing and operating an Advant Controller system to minimize the risks of injury to personnel and damage to the equipment. Local statutory regulations, to the degree that they are stricter than the following instructions, take precedence.

2.2.1.1 Personnel and Process Safety

DANGER - CAUTION

Observe the following:

- Use only approved hoisting equipment when lifting cabinets. See lifting instructions enclosed with the cabinet.
- Never switch on the voltage supply of the cabinet during installation work.
- **Work with care when supply voltage is applied in the system. The voltage in the cabinet can cause injury and can even kill a human being.**
- Make sure that everyone working on the installation knows the location of the safety switch and the main power supply switch to the Advant Controller 110 equipment and how to use it.
- When the subsections of the process are checked and a test run has been performed, a responsible person is to check out interlocking chains, and so on.
  Inform all assembly personnel about test runs to be performed.
- Process technicians are to be present when testing and operating the process objects.
- Never press the system INIT (initialization) button if you do not know what happens in the system with an initialization (see Section 2.4, Start-up Procedures).
- Remember that the control system can be controlled from an engineering station connected at another node via AF 100. For example it can be stopped, configured, and started remotely.
- Remember that an Advant Controller 110 starts automatically when voltage is applied if this is not prevented by setting the START MODE selector in the STOP position.

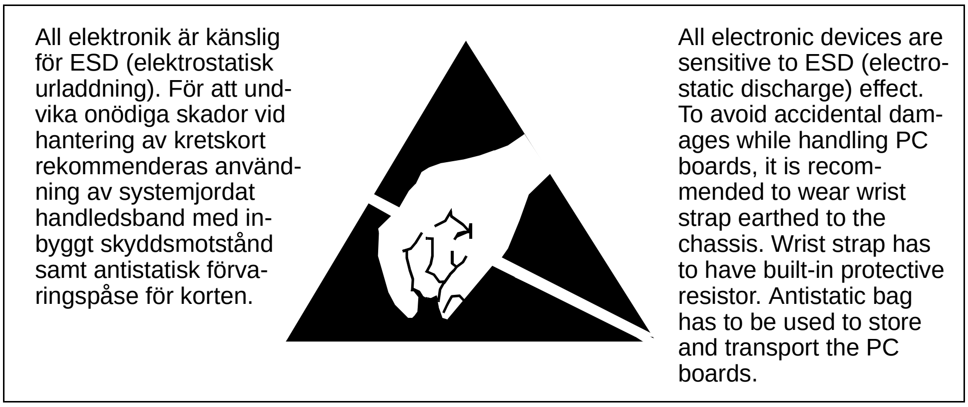
2.2.1.2 Machine Safety

CAUTION

Observe the following safety rules:

- Avoid discharges of static electricity by grounding both yourself and tools before handling circuit boards and other parts of the equipment.
- Use the grounded wristband installed in the cabinet and the available folding working surface (service shelf) when handling parts of the system.
- Handle the circuit boards carefully, particularly those which contain MOS components which can be damaged by static electricity discharges. Note the warning label on the circuit boards.

- Use, as far as possible, the grounded wristband when handling boards not stored in envelopes of conductive plastic. This gives optimum protection against static electricity discharges.
- Always store circuit boards in envelopes of conductive plastic when not installed in the system rack.
- Always switch off the voltage before extracting a board which cannot be exchanged while under voltage. See Chapter 5, Maintenance. Wait a sufficient time for the capacitors to discharge.
- Switch off voltage to the system and withdraw all boards at least 20 mm before electrical welding is performed near the controller system.
- A warning label is fixed in the system to draw attention to possible damage by ESD (Electro Static Discharge).



All elektronik är känslig för ESD (elektrostatisk urladdning). För att undvika onödiga skador vid hantering av kretskort rekommenderas användning av systemjordat handledsband med inbyggt skyddsmotstånd samt antistatisk förvaringspåse för korten.

All electronic devices are sensitive to ESD (electrostatic discharge) effect. To avoid accidental damages while handling PC boards, it is recommended to wear wrist strap earthed to the chassis. Wrist strap has to have built-in protective resistor. Antistatic bag has to be used to store and transport the PC boards.

Figure 2-5. Warning Label Regarding ESD

2.2.2 Unpacking and Storing

If the packaging is opened for a delivery check, reseal it if the cabinets are not to be installed immediately.
Store cabinets in a dry place, protected again dust. See the data sheet *ABB Master Environmental Immunity.*

Avoid fixing labels on painted surfaces. If these remain in place too long, the surface can be affected.

Use care when unloading and transporting cabinets. A fork-lift truck is usually the most suitable means of transport. Cabinets are fitted with lifting eye bolts to facilitate transport with a crane.

NOTE

Observe lifting instructions enclosed with the cabinet!

Temporary Installation of Heating Element

If a cabinet is provided with a heating element, activate it as soon as possible after the cabinet is unpacked to prevent corrosion.

Connect the mains supply a.c. (phase, return, and protective earth) directly to the terminal blocks of the element unit.
Make the connection **temporarily**. See the delivery documentation for information on element location and terminals to be used.
When the cabinet is finally installed, supply the element according to the information given in Section 2.2.10, Power Supply Connection.

2.2.3 Location

The cabinet is to stand on a stable floor, deck, or supporting structure, free from vibrations, and is to be either screwed or welded to this surface. Minimum distances to walls and ceiling are listed in the Section 2.1.12, Weight and Mounting Dimensions.

Access to the rear of the cabinet is not necessary.

If required, you can remove the wall cladding on the sides in contact when two or more cabinets related to one controller with I/O are installed next to each other. The width of the cabinets is reduced by 35 mm for each panel removed.

2.2.4 Erecting the Cabinets

The floor should be level and well suited for erection (Swedish building standard-AMA tolerance 3B or class 2), so that a number of cabinets can be bolted together without any additional work being required.

If the floor is not sufficiently level, the cabinet base may be askew, making it difficult to open or close doors.

When you are erecting the cabinets, you can move them to the right position by inserting spacers, and so on, between the base frame and the ground. You can raise the cabinets using adjusting bolts in the base (one in each corner) before they are erected.

NOTE

Cabinets must not rest on the adjusting screws after erection.

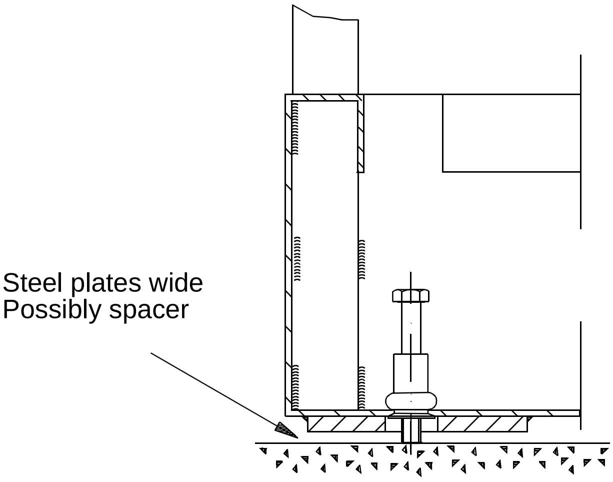


Figure 2-6. Cabinet Leveling Screws

2.2.5 Cabinets Screwed Together

The cabinet sides feature eight holes for screwing cabinets together with M8x12 screws, washers, and nuts.

Tighten the screws to 20 Nm maximum.

With sealed cabinets, fix a self-adhesive foam rubber strip around the edges of one side wall before screwing the cabinets together.

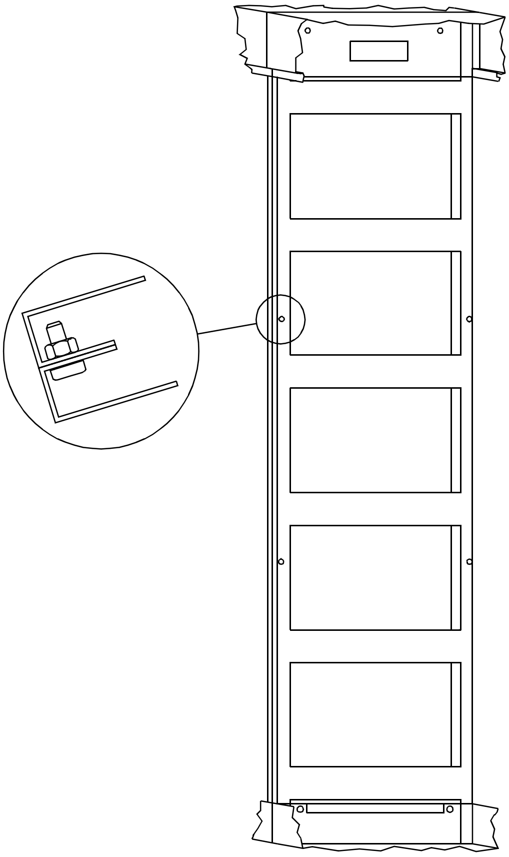


Figure 2-7. Screwed Connections

2.2.6 Fixing Cabinet to Floor

Different methods for fixing a cabinet to the floor follow.

Screwing to Floor

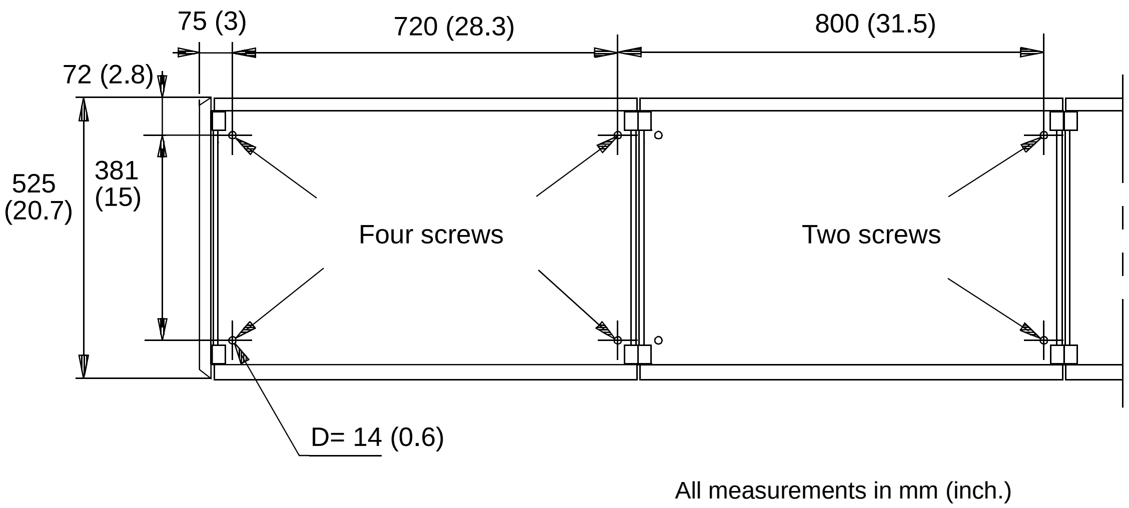


Figure 2-8. Screwing of Cabinet to Floor

Screw individual cabinets and the first (left-hand) cabinet in a row of cabinets to the floor with four screws, one at each corner. Screw the other cabinets to the floor with two screws each at the right.

The bottom features holes, 14 mm (0.6") in diameter. These holes permit you to adjust the cabinet location after holes are drilled in the floor.

If drilling is necessary, make sure that no dust or other foreign matter enters the equipment in the cabinet.

See Figure 2-6, Figure 2-8, and Figure 2-9.

Welding to Steel Section

CAUTION

All circuit boards must be extracted before any welding work is performed.

See Figure 2-10.

Fixing to Computer Room Floor

When the fixing points in the cabinets do not coincide with the structural beams, you must fix the cabinet to the floor itself using expander bolts.

See Figure 2-11 and Figure 2-12.

Examples of Installation Details

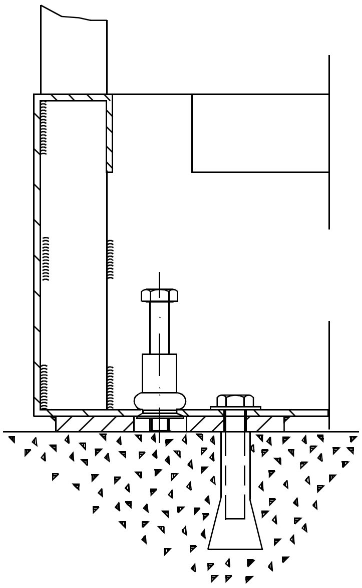


Figure 2-9. Screwing Through Holes in Bottom

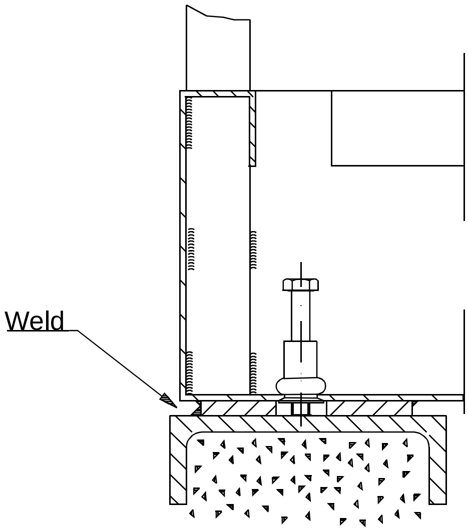


Figure 2-10. Fixing of Cabinet by Welding to Steel Section

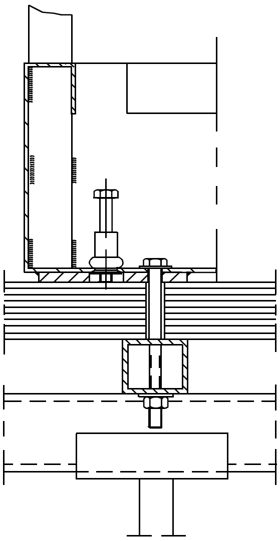


Figure 2-11. Fixing of Cabinet to Computer Room Floor, Variant 1

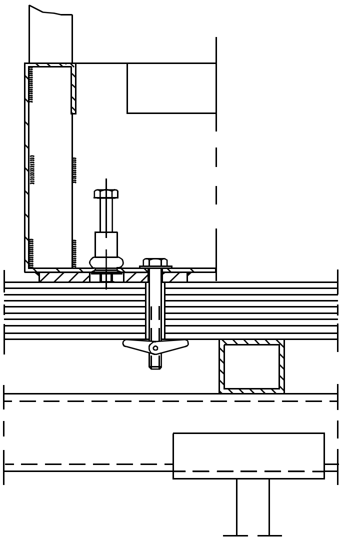


Figure 2-12. Fixing of Cabinet to Computer Room Floor, Variant 2

2.2.7 Grounding

This section shows you **where** to ground in an Advant Controller cabinet. If necessary, it also shows you **how** to ground.

You should be aware of the common *Advant OCS Installation Rules*, which establish the principles of grounding and answer the questions of **when** a piece of equipment, a circuit, or a cable shield should be grounded and **why** it should be grounded. It also gives alternative solutions adapted to specific plant requirements.

2.2.7.1 General

An RM500 cabinet forms a stable ground plane for all equipment accommodated.

The signal processing electronics in the controller, as well as all interference suppression for external signals, are normally directly grounded to chassis and plant earth.

2.2.7.2 Protective Earth

The mains distribution normally includes a protected earth (PE) wire. Connect this to the PE terminal block on the primary Power Switch Unit or the Mains Net Filter, if included. (See the circuit diagram enclosed at delivery.)

You are directed to use cable lug connectors when connecting to any earth screw.

2.2.7.3 Earth Line

Ground the cabinet with a copper lead (≥ 35 mm) to the plant earth line.

Use any of four earth screws placed in the corners of the cabinet floor.
You are directed to use a cable lug connector.

Individually connect several cabinets in a row to the plant earth line.

2.2.7.4 Grounding of Process Cable Shields

General

Advant OCS or rather the application itself put some limited requirement on cable shielding. Only a few types of process signals must be shielded and treated in a special way when entering the controller cabinet. In the continued description of CE-marked and not CE-marked controller design these cables are denoted **category A** and they include:

- Low level analog input signals
  - Accuracy requirement ≥ 12 bits
  - Pt 100 and Thermocouple
- High-frequency pulse transmitter signals.

Normally a single shield is used and it is grounded in the controller end of the cable. Sometimes the application require a local grounding of the cable shield close to the transducer. Specific rules apply then.

By different reasons other field cables may be shielded too. For example following a company/plant standard. There is no requirement from the controller viewpoint. These field cables are denoted **category B**.

To get a comprehensive view also the treatment of **unshielded** cables are described below.

Common to all cabinet designs are the horizontal mounting bars (DIN) close to the bottom of the cabinet. One bar at the left-hand side and one at the right-hand side. They are used to mechanically anchoring all types of field cables, shielded and unshielded, when entering the cabinet. You use a cable clamp to press the cable against the bar or adjacent cable if several cables are pressed together. Which bar you use depends on the further routing of the cable in the cabinet. See Section 2.2.8, Cable Routing in Cabinets.

CE-marked Design

Shields of **category A** cables which are to be directly grounded in the cabinet must be **additionally** grounded close to their entrance in the cabinet. The cable sealing at the bottom plate is used according to Figure 2-13 below. The shield must then be run all the way up to the relevant S600 I/O module as shown in the Figure 2-13.

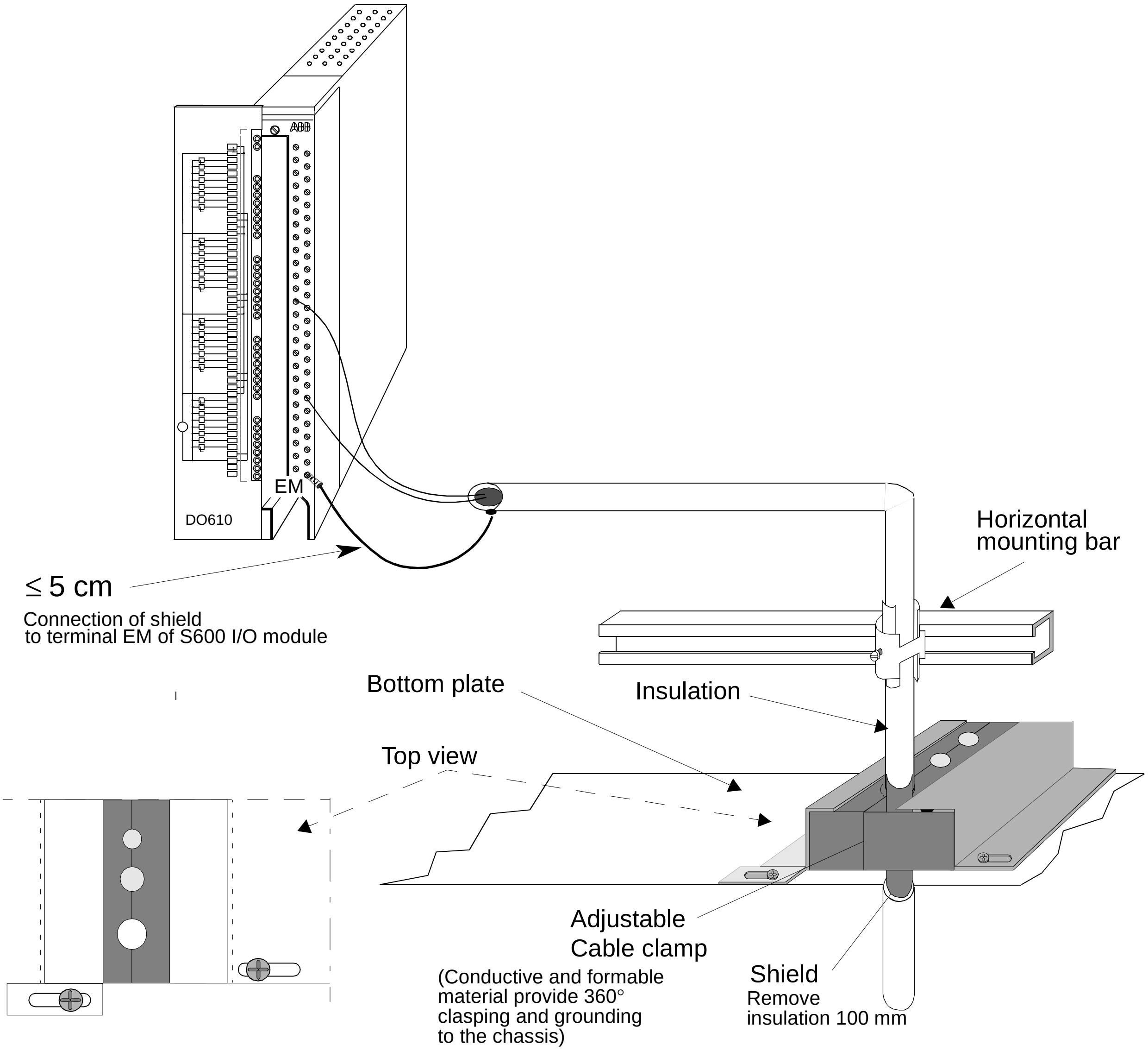


Figure 2-13. Handling of Cable Shields in CE-marked Cabinet (Example with S600 I/O)

If there is a requirement of local grounding of a cable shield for, for example, a thermocouple application, cable with double shield should be used. The inner shield is grounded locally at the transducer while the outer shield is grounded according to Figure 2-13.

Shielded cables of the category A which are grounded locally at the transducer are alternatively to be connected via a capacitive decoupling device, located in the bottom of the cabinet.

That is, similar solution to that used for certain communication cables. See Section 2.2.7.5, Grounding of Communication Cable Shields.

Shields of **category B** cables can be handled at the entrance of the cabinet in the same way as category A cables.

If the shielded I/O process cable is connected to a terminal unit an internal shielded process cable between S600 I/O module and terminal unit is used. The shield of this internal cable is connected to the shield of the incoming I/O process cable at the terminal unit (by connecting both shields to the same screw terminal of the terminal unit).

Unshielded process I/O cables can be mixed with shielded process I/O cables. However to get the best grounding of existing shields by the cable sealing at the bottom of the cabinet you should preferably arrange shielded and unshielded cables separated in groups. Try to mix cables with different dimensions in a way that ensure best possible connection of shields to ground (clasp 360°).

Not CE-marked Design

If a conventional cabinet is used the attachment of the cable shield and anchoring of the cable is co-ordinated by using the horizontal mounting bar, see Figure 2-14. The shield of a **category A** cable must furthermore be run all the way up to the relevant connector or EM-terminal of connector. The point of grounding is shown in Figure 2-13. Use a short lead ≤ 50 mm.

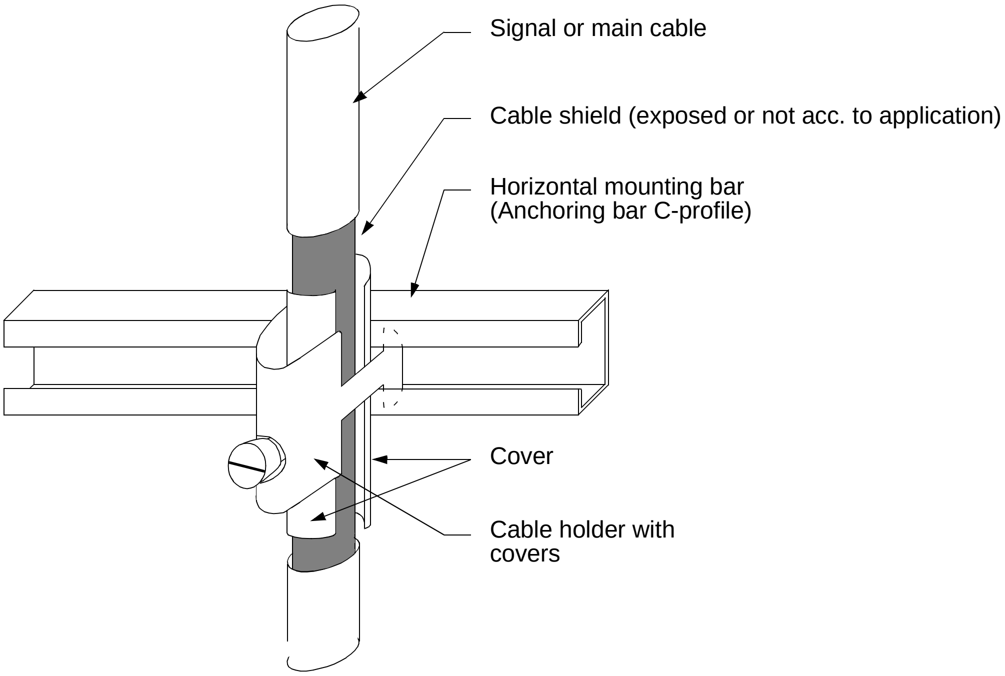

Signal or main cable
Cable shield (exposed or not acc. to application)
Horizontal mounting bar
(Anchoring bar C-profile)
Cover
Cable holder with
covers

Figure 2-14. Handling of Cable Shields in Not CE-marked Cabinet

Shielded cables of the category A which are grounded locally at the transducer shall be left ungrounded in a cabinet which is not CE-marked.

Unshielded process I/O cables can be mixed with shielded process I/O cables.

2.2.7.5 Grounding of Communication Cable Shields

General

Communication cables shall be routed directly to the actual connection unit, modem, or communication module in a subrack. Never open up a cable shield when entering the cabinet. The grounding of the shield to the chassis, directly or via a capacitor, is normally determined by the type of communication. You must reflect the whole installation of the communication bus to comply with a main rule: A bus communication cable shield must be directly grounded but only in one end of the bus. That is, in the cabinet where the first/last connected Advant Controller (or other node) is located.

This instruction is valid to coax cable and conventional shielded multi-lead cable as well. It is a supplement to the installation information given in separate communication user's guides.

CE-marked Design

In addition to the general instruction found above, further interference suppression of the cable shield is made at the enclosure port by individual methods adapted to the different types of communication. The schematic principles of direct grounding and h.f. grounding by a capacitor are shown in Figure 2-15.

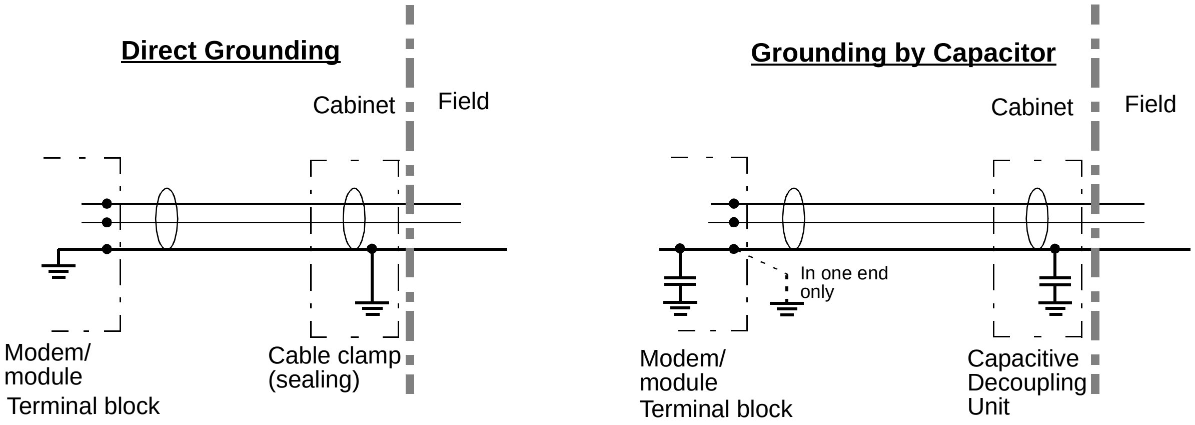


Figure 2-15. Principles of Grounding of Communication Cable Shields in CE-marked Design

For direct grounding of the communication cable shield, the illustration in Figure 2-13 is applicable.

The grounding via a capacitor is based on a Capacitive Decoupling Unit, which is mounted on the horizontal mounting bar. The cable then passes the sealing at the cabinet bottom unstripped. See Figure 2-16.

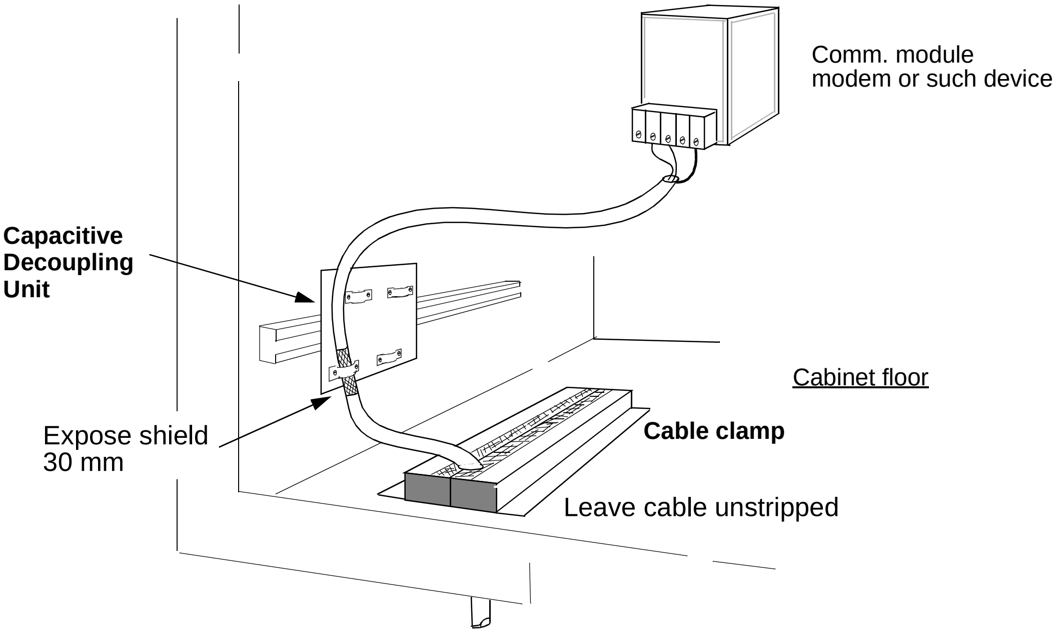


Figure 2-16. Communication Cable Shield Grounded by Capacitor

Each unit takes up to four communication cables and it also provides the mechanical anchoring of the cable. Two units can be mounted side by side or, if necessary, on top of each other. Certain spacers are used then. This implies a maximum of 4 units on a mounting bar (16 buses).
The application of method with respect to communication type is given in Table 2-1

Table 2-1. Methods of Handling Communication Cable Shields

Type of Communication	Grounding of Shield Directly	Grounding of Shield via Capacitor
Advant Fieldbus 100, Coax	--	Yes
Advant Fieldbus 100, Twisted pair	--	Yes
MasterFieldbus, Long Distance Bus	--	Yes
MasterFieldbus, Short Distance Bus	Yes (in both ends!)	--
RCOM, EXCOM, MODBUS I, SIEMENS 3964(R)	Yes	--
V24/RS-232-C, for example for a panel	Yes	--
Bus Extension to S600 I/O	Refer to Section 2.2.13, Bus Extension to S600 I/O	

Not CE-marked Design

The description given under the heading **General** is adequate. The cable is mechanically anchored to the horizontal mounting bar close to the bottom of the cabinet. Leave the cable unstripped. Use a cable clamp to press the cable against the bar or adjacent cable if several cables are pressed together.

2.2.7.6 Grounding of Process Signals

There are three applications of signal grounding directly to the chassis. (High-frequency grounding by capacitors is always provided and not discussed in this context.)

1. Signals can be grounded to the chassis by the S600 I/O module. This quality is determined by the selection of I/O modules. Some I/O module types require grounded signals while others can be applied to non-grounded signals (and grounded).
   See the *S600 I/O Reference Manual* on a case-by-case basis.
2. Signals can be commonly grounded by grounding the reference 0V of centralized power supply for loads and sensing. Such a power supply system must be grounded to the same earth line as the Advant OCS.
   If the power supply unit is placed in the controller or I/O cabinet, 0V is grounded to the protective earth screw.
   Local grounding of loads and sensors is then impossible!
3. Individual grounding of a signal in the controller cabinet is possible (if it is applicable with respect to module type selected).
   The 0 V signal connection at the I/O module is reconnected and grounded to the mounting rail. Lead length is not critical.
   Such an application requires that the signal not be grounded otherwise, for example, not locally grounded at load/sensor or not grounded via a power supply grounding.

   You must follow the main rule: Do not ground a signal at different points in the plant

2.2.7.7 Grounding of Additional Equipment

Treat additional power supply units of different types, aimed at load/sensor supply and modems, and so on, erected in the controller or I/O cabinet, in the following way with respect to grounding:

- Connect the apparatus chassis (or PE terminal) to the protective ground via one of the power distribution sockets on the power switch unit or directly to the cabinet chassis.
- Consider application-adapted grounding of power supply 0 V. If desirable, connect the 0 V terminal to the chassis. It is preferable that you use the protective earth screw.

2.2.7.8 Spare Conductors

Spares in field cables are to be grounded within a cabinet, in case of a CE-marked design.

2.2.8 Cable Routing in Cabinets

Cables are practically routed on either side of the cabinet depending on the final destination. The physical item destination for an actual apparatus, and thereby the connection point, appears in the circuit diagrams and other installation drawings enclosed at delivery.

The assigned space for cables that are entered in the floor opening is shown in Figure 2-17.

For your information, the space for the factory assembled cables is also indicated in Figure 2-17. Regard the latter cables and leads as sensitive to disturbances and keep them away from cables coming from the plant. You will encounter these areas only when the system is enlarged by additional equipment, for example, a module and terminal unit.

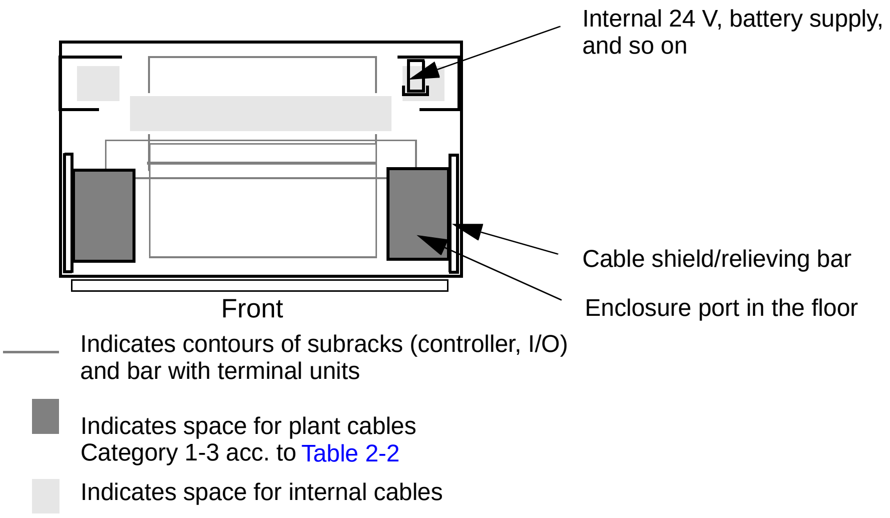

Internal 24 V, battery supply, and so on
Cable shield/relieving bar
Enclosure port in the floor
Front
Indicates contours of subracks (controller, I/O) and bar with terminal units
Indicates space for plant cables Category 1-3 acc. to Table 2-2
Indicates space for internal cables

Figure 2-17. Assigned Space for Cables in Cabinet

There are some restrictions in mixing cables within a cabinet due to the risk of interference. To describe the simple rules applicable at site installation, cables are divided in categories. See Table 2-2 and the following rules:

- Within a category, you can mix cables arbitrarily.
- Keep the distance between cables belonging to different categories ≥50 mm.
- "Cabinet internal" couplings have their own defined spaces for routing. Always keep the distance to other cables ≥50 mm.

Table 2-2. Cable Categories in Cabinet

Cable /Application	Category
Power supply a.c. or d.c.	1
Process I/O, shielded and unshielded cables	2
Communication	2
Clock sync., and so on	2
Bus extension to S600 I/O (1)	3

(1) Bus extension for S600 I/O is normally routed between cabinets in a special way, as illustrated in Section 2.2.13, Bus Extension to S600 I/O.

Route cables in horizontal cable ducts when applicable.

Fix cables with cable straps.

2.2.9 Radio-Proof Cabinet

The RM500 cabinets are available in radio-proof configurations.

Certain installation rules apply. Refer to the particular sections in this Users' Guide.

2.2.10 Power Supply Connection

2.2.10.1 General

Cabinets erected side by side, including a controller and I/O configuration, are regarded as a unit which is joined to the power supply network at one single connecting point, a centralized power switch unit. The switch unit is normally located in the controller cabinet.

The power supply is distributed to the I/O cabinets according to application. The power supply modules in I/O cabinets are connected to the switch unit via ready-made cables and plug-in contacts.

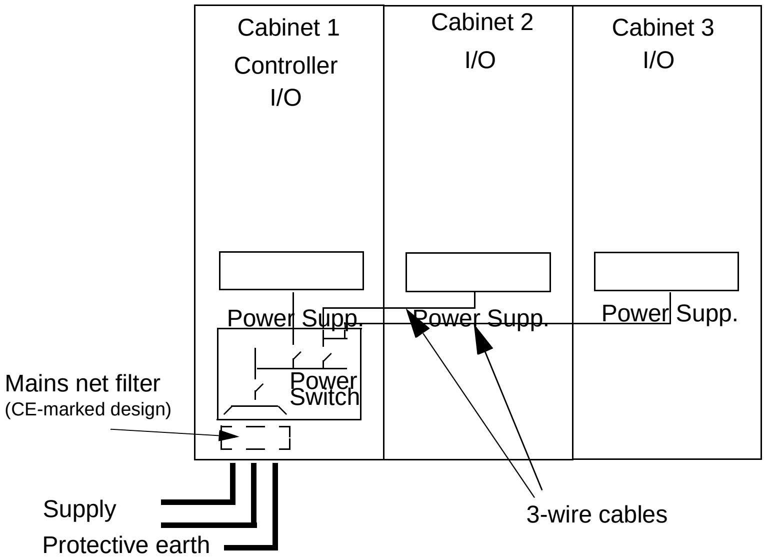


Figure 2-18. Main Principle of Power Supply Connection and Distribution

Mains Power Switch and Distribution

You use the power switch and distribution unit to connect and disconnect the Advant Controller 110 system to the mains and for distribution of voltage to different units in the cabinet. The power switch unit contains terminal blocks, miniature circuit breakers, and power outlets for, for example, voltage supply units.

Normally, a common circuit breaker disconnects the mains from all cabinets housing the controller and the S600 I/O installation, that is, "hard" related cabinets. Variants can exist. Refer to the actual delivery documentation for further information.

You can find more information about distribution units and power switch in Appendix C, Cabinet Configuration.

2.2.10.2 Connection of Power Supply Module SA610

In addition to the bus extension connector, both the basic subrack RF615 and the extension subrack RF620 have terminals for linking the station supply voltages. These terminals are located on the right-hand side of the subracks. There are two sets of terminals, which enable you to connect the two power supplies (USA and USB). PCB supply rails connect both sets of terminals to all positions.

The station voltage terminals of the basic and the extension subrack must be interconnected. A missing connection can prevent proper operation of the system. If redundant power supply is applied, two station voltage cables TK615 are required.

If you are supplying both the basic subrack and the extension subrack from an in-line power supply module SA610, you must connect the supply terminals of the two subracks by a cable TK615. This cable is a two-pole cable 1.5 mm^2 with Faston terminals designed for the normal distance between the two subracks. It can be connected between USA-USA or USB-USB terminals.

The rated supply voltage for the modules in the station is 24 V DC. The permissible range of supply voltage is 18 - 30 volts measured at the terminals.

The subracks must be earthed via a conductor protective earth (PE). Where both a basic and an extension subrack are installed, connect both to the PE conductor (see Figure 2-19). Connect the PE conductor with a screw to the earthing/grounding hole located on the right-hand side of the metal base plate of the subrack.

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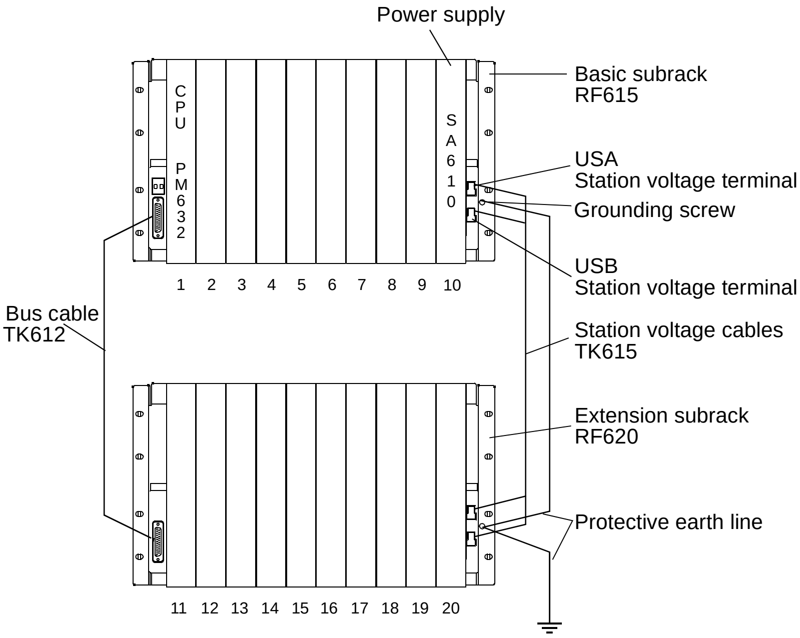


Figure 2-19. Advant Controller 110 with Power Supply Module SA610

2.2.10.3 Supervision for Power Supply Module SA610

The following figures illustrate two examples of possible configurations:

- Single configuration
- Parallel configuration.

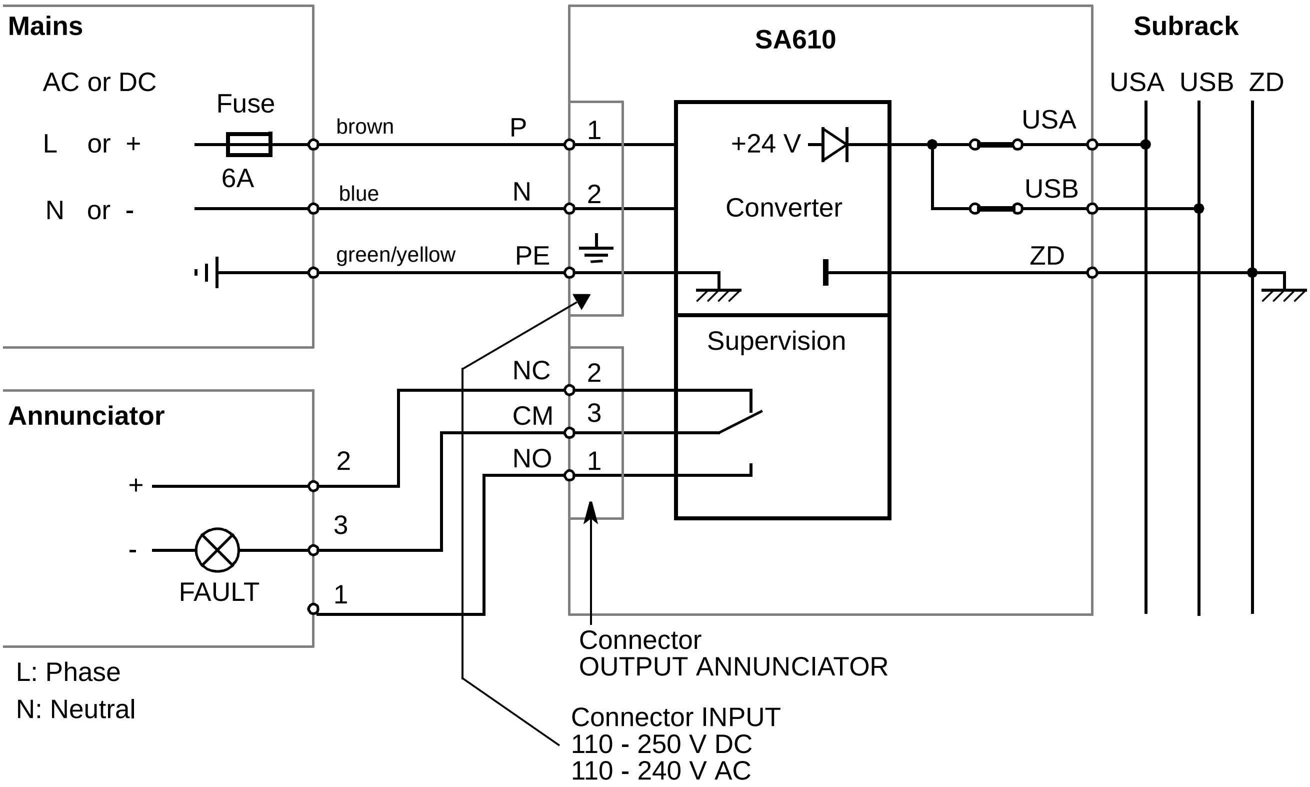


Figure 2-20. SA610 Connections for Single Configuration

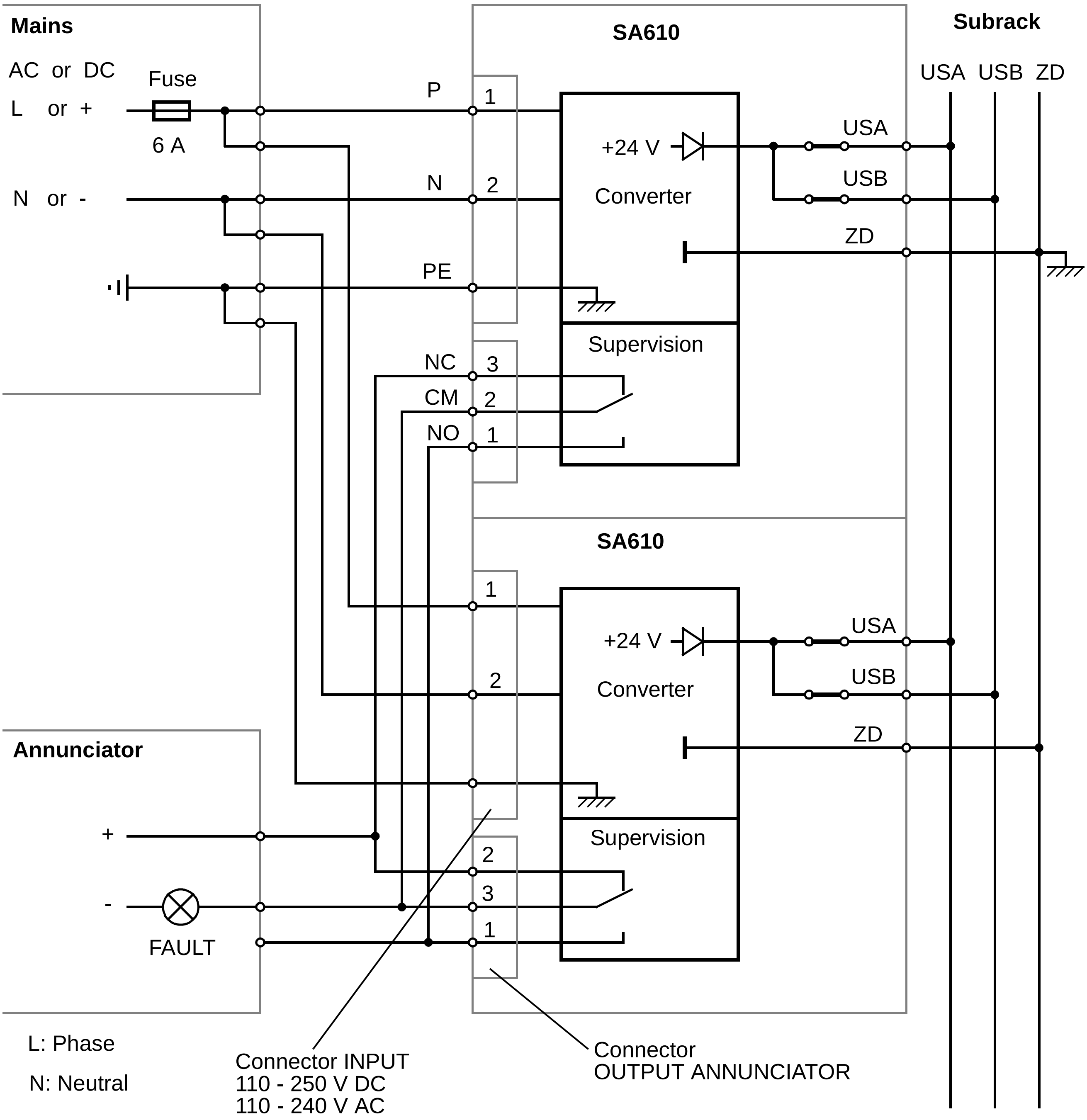


Figure 2-21. SA610 Connections for Parallel Configuration

2.2.10.4 Installation

General

Ordering documents show which power supply alternative is applied.
An a.c., d.c., redundant, or non-redundant supply is connected to the controller in the same way, in principle. A terminal diagram form enclosed at delivery shows the relevant physical item designations and connection points in the cabinet. You will also find the denominations supply A, B, and C applicable.

A summary of the main requirements of the networks A, B, and C are given in Section 2.1.7, Power Supply and Fusing.

The installation work to be done, supported by the terminal diagram form (circuit diagram), is:

- Connect network A.
- Connect network B (if redundancy).
- Connect network C.
- Connect the power supply modules located in I/O cabinets. Use the ready-made cables and plug-in contacts. They are marked with the destination item designations.

CE-marked Design

Protection against line conducted radio emission is obtained by means of a special filter placed in the bottom of the cabinet on the incoming supply. One filter for each supply is utilized.

The cable length between the entrance of the cabinet and the net filter should be as short as possible.

Not CE-marked Design

No additional information than that given under the heading General apply.

2.2.10.5 Heating Element

If a heating element is included in the cabinet, connect it appropriately with respect to external safety switches. Do not disconnect it by the cabinet power switch unit. The element is automatically disconnected by a relay when the equipment is in operation (24 V d.c. switched on).

2.2.10.6 Preparation for Start-up

Check that the circuit breakers on the power switch units are switched off.

Reflect the relevance of:

- Power switch in the cabinet housing the controller subrack
- Separate power switch in physically distributed cluster of S600 I/O subrack.

2.2.11 Bus Connection to Extension Subrack

Cable TK612 makes the connection between the sub-D connectors on the basic subrack and the extension subrack (see Figure 2-19). Do not use any cables other than the TK612 because the connector pin allocation, the cable impedance and the cable length are precisely optimized for bus extension operation.

2.2.12 Controller

Assembly

All equipment included in the controller is factory assembled. Cabinet erection and similar questions are dealt with in the general setup instructions above.

Electric Installation

Apart from the process I/O connections and communication connections, which are treated separately, there is little electric installation. Grounding of the cabinet, equipment, cable shields, and so on, and power supply connection are covered in the general setup instructions above. In addition to that, make the following connections of functions when appropriate:

- Run/Alarm relay
- External clock synchronization (processor modules PM633 and PM634)
- Power supply supervision (see Section 2.2.10.3, Supervision for Power Supply Module SA610).

The location of the connections within the cabinet are specified in the terminal diagram form enclosed at delivery.

Run/Alarm Relay

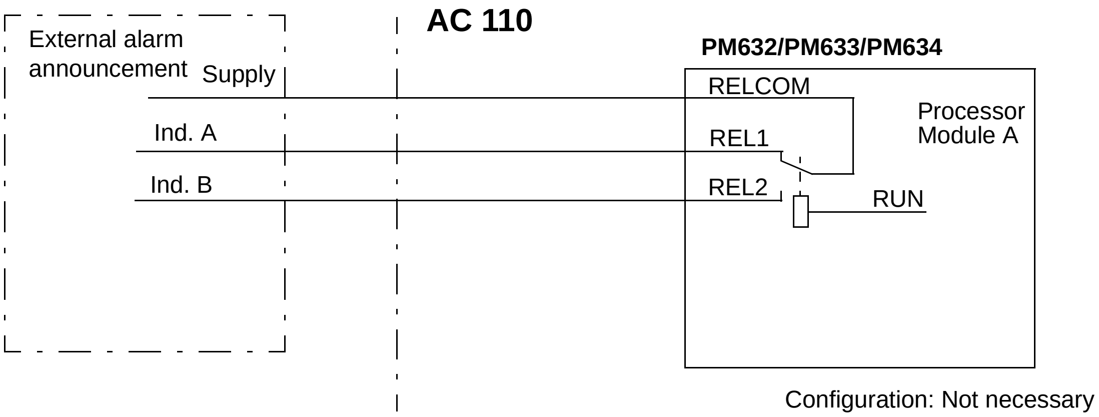


Figure 2-22. Connection of Run/Alarm Relay

External Clock Synchronization

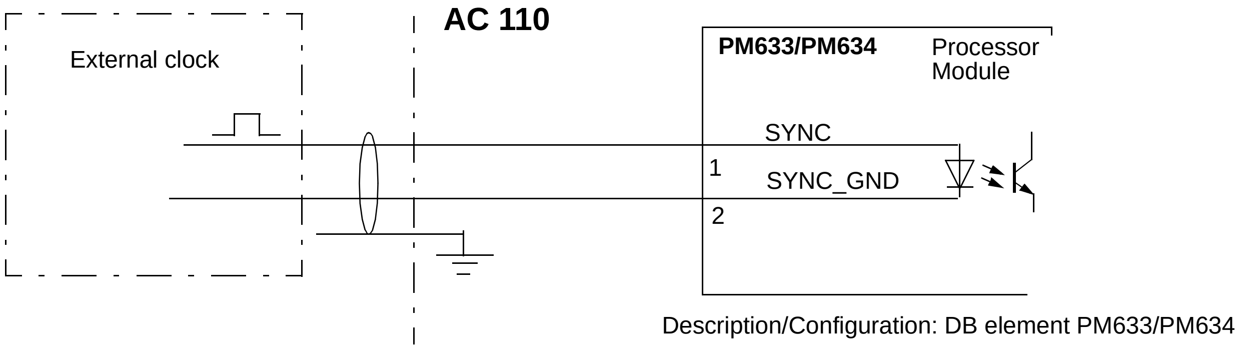


Figure 2-23. Connection of External Clock Synchronization

Preparation for Start-up

See the general checklists in Section 2.2.19, Checklists.

Remove the battery from spare part processor modules. Otherwise, it will be discharged in a few months.

2.2.13 Bus Extension to S600 I/O

You can use the following basic information when you install an electrical bus extension.

Assembly

The different parts of the bus extension are mainly factory assembled. These include:

- Bus extender module CI615 in the base station
- Bus extender module, each located in separate I/O stations
- Bus extension cables connecting subracks within a cabinet.

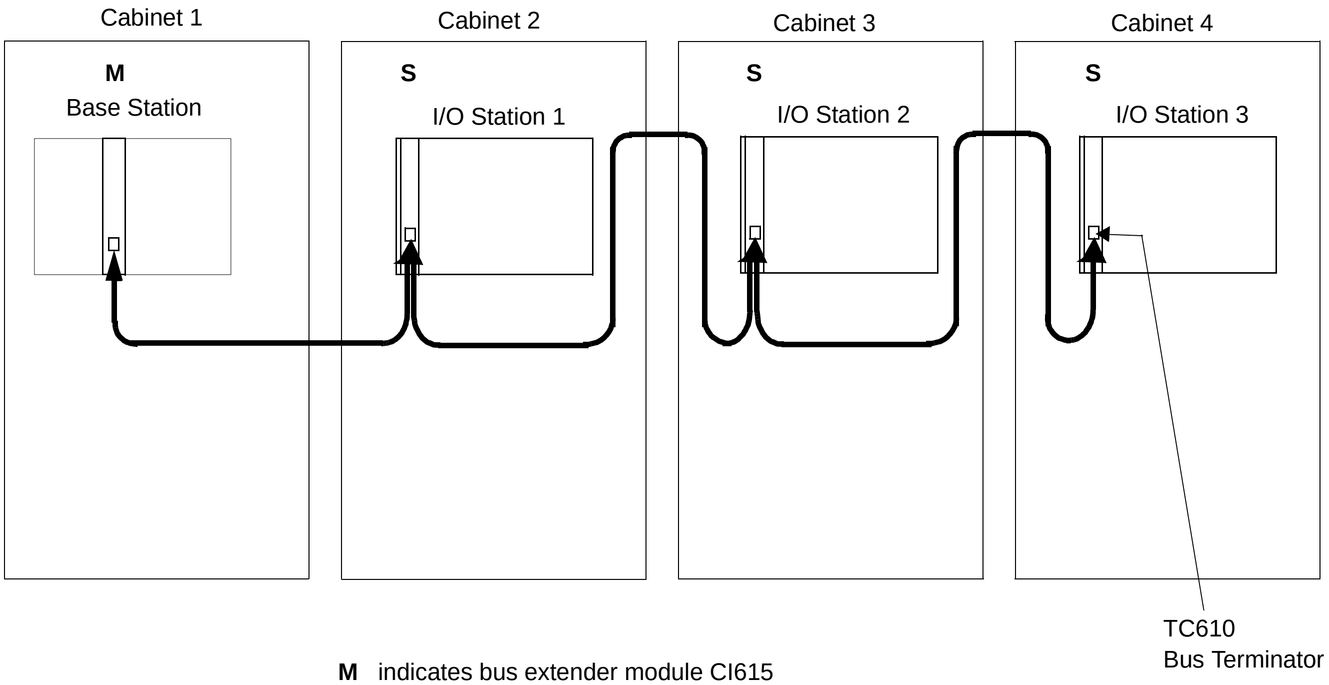
You are supposed to make the interconnection of the bus extension between cabinets. Cabinets should be erected side by side in a designated order. Ribbon cables with adapted lengths are enclosed at delivery. **Use these cables!**
It is important not to exceed the maximum bus length 20 m, that is, the total length of the cables used may not exceed 20 m.

Check that a plug-in bus terminator TC610 is located only on the last bus extender module in the chain. See Figure 2-24.

Electric Installation

Make use of the enclosed bus extension cables to interconnect the bus between the cabinets. Such a cable is connected at one end and temporarily wound up and hung up on the wall side.

Figure 2-24 shows an example of an installation. The actual bus extension cables are illustrated with a thick line.



M indicates bus extender module CI615
Connection on module front

S indicates bus extender module CI610
Connection on module front

Figure 2-24. Example of Bus Extension

Since no intermediate side walls or plates are used on a cabinet within a row, draw the bus extension cables directly between the cabinets.

The bus extension cables are sensitive to interference. Locate them at least 100 mm away from other cables and wires in the cabinet.

Ensure that there is no tension in the wiring.

Carefully fix the bus extension cables to fixing bars or the like with the help of cable straps.

If for some reason the cabinets are not erected side by side then the bus extension cable must be routed separated from other cables (>100 mm). A CE-marked design put the requirement that the extension cable shield is additionally grounded by the cable clamp in the cabinet floor.

Preparation for Start-up

See the general checklist in Section 2.2.19, Checklists.

2.2.14 S600 I/O

2.2.14.1 Modules

S600 I/O is the group of input and output modules located in the base or extension subrack (see (Section 2.2.14.2, Assembly).

A module comprises steel plates joined together to form a box. A module contains a PCB with all the electronic circuits needed to carry out the specified function, the connector to the backplane bus in the subrack (see Figure 2-32), and the connector for the process cables or communication cables (see Figure 2-25).

The metallic enclosure of the modules protects the electronics.

All connectors for process signals and communication cables are accessible from the front. The connectors are mounted behind the hinged front door of the modules. You must open the front door to gain access to the connectors. You will find a terminal diagram showing the signal connections on the inside of the front door.

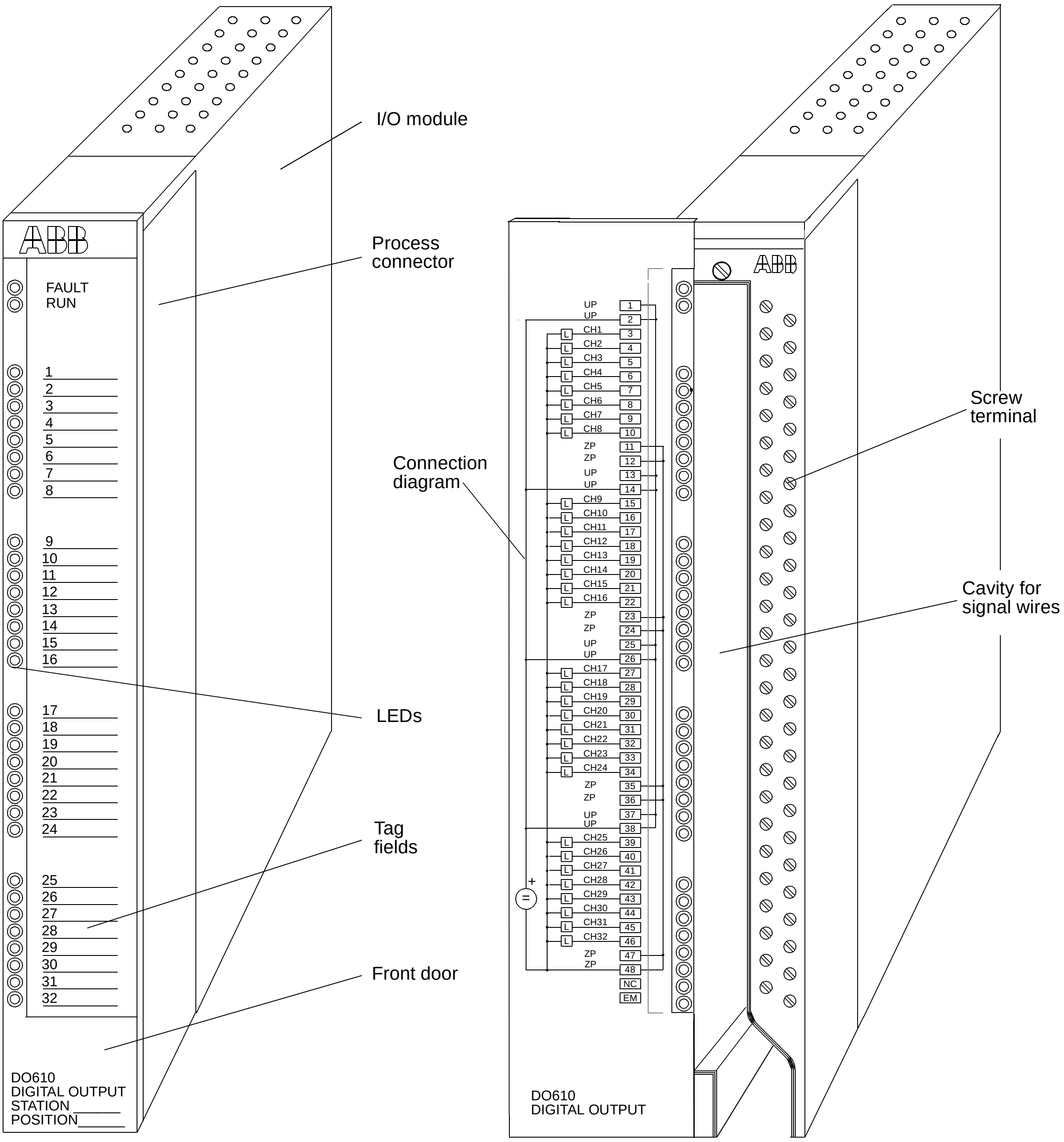
The I/O signals are connected to the process connector. There are four different versions of the process connector: one with screw terminals, one with crimp terminals and two with cables with loose ends (shielded or unshielded cables).

You can remove the process connector while the process signals are active. Then you can replace an I/O module. A module automatically ceases to function when the process connector is removed.

The status of the module and the process signals is indicated by LEDs on the front. Each module has a green LED RUN and a red LED FAULT. The LED RUN indicates that the module is in operation. The LED FAULT indicates that the diagnostic function has detected a defect in the module.

There is a paper strip on the front door for marking the functions of the LED indicators and the process signals. The module type and the channel numbers are already printed on the paper strip. You can add text for each of the channels. The paper strip also includes space for the station number and position number of the module, to ensure that the strips are attached to the right module.

The enclosure has openings on the top and bottom for ventilation. The enclosure complies with protection class IP20 according to IEC 529 (equal to NEMA 1).



Front door closed

Front door open

Figure 2-25. I/O Module with Process Connector

Process Connectors

S600 I/O modules are connected to the process by a connector located on the front of the module. There are two types of process connectors:

- Process connects with preassembled process cables
- Process connects with screw terminals (TF620).

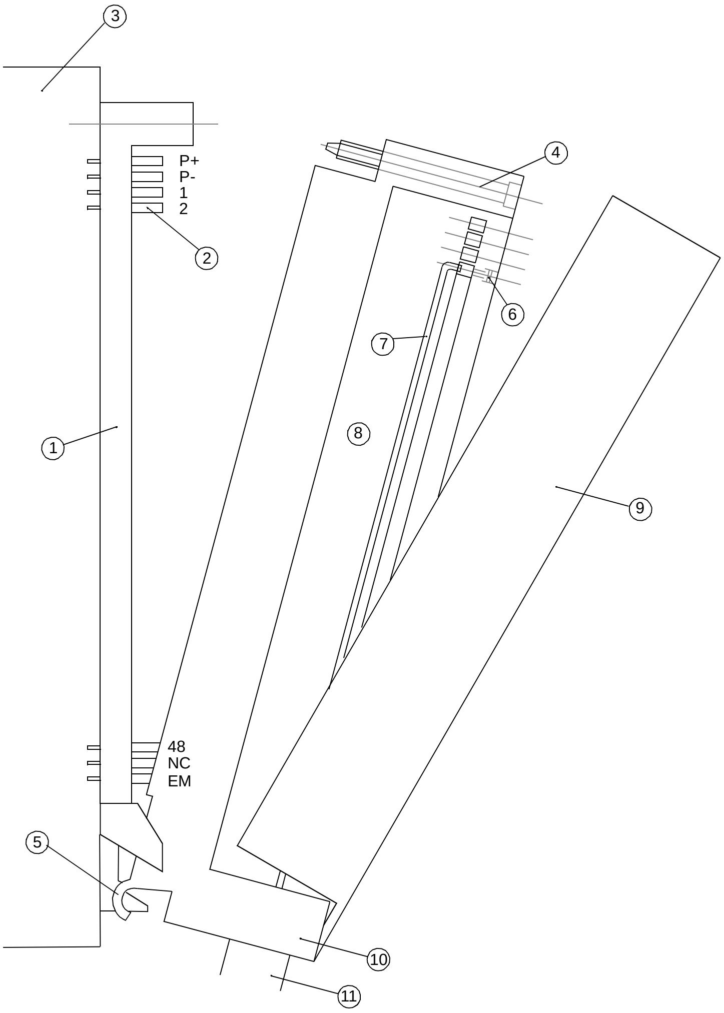
Preassembled process cables are fitted with a connector with crimp terminals.

Process Connectors with Screw Terminals

The designation of the connector with screw terminals is TF620. The connector has 52 contacts, 50 of which are accessible and have screw terminals. The two uppermost contacts, marked P+ and P-, are connected by a wire jumper for a special use and are not accessible. Up to 48 of the screw terminal contacts are used for process signals. One contact is used for connecting a cable shield (EM) and one contact is not used (NC).

The screw terminals can accommodate wire gauges from 0.5 mm^2 to 1.5 mm^2. The maximum wire gauge is 2.6 mm^2. The connector's cavity for the cable has a dimension of 24 x 40 mm. The cable can be clamped with two nylon straps. The wire entrance part of the connector has a dimension of 16 x 40 mm^2.

The connector is supplied with a cover fitted over the contacts, making it safe for high-voltage use.



① Multipoint connector plug (part of module)
② Blade contact
③ PC board of the I/O module
④ Fixing screw of for multipoint connector
⑤ Hook
⑥ Screw
⑦ Process cables
⑧ Space for process cables
⑨ Cover
⑩ Pivot
⑪ Process cable

Figure 2-26. Process Connector with Screw Terminals

Process Connectors with Cable

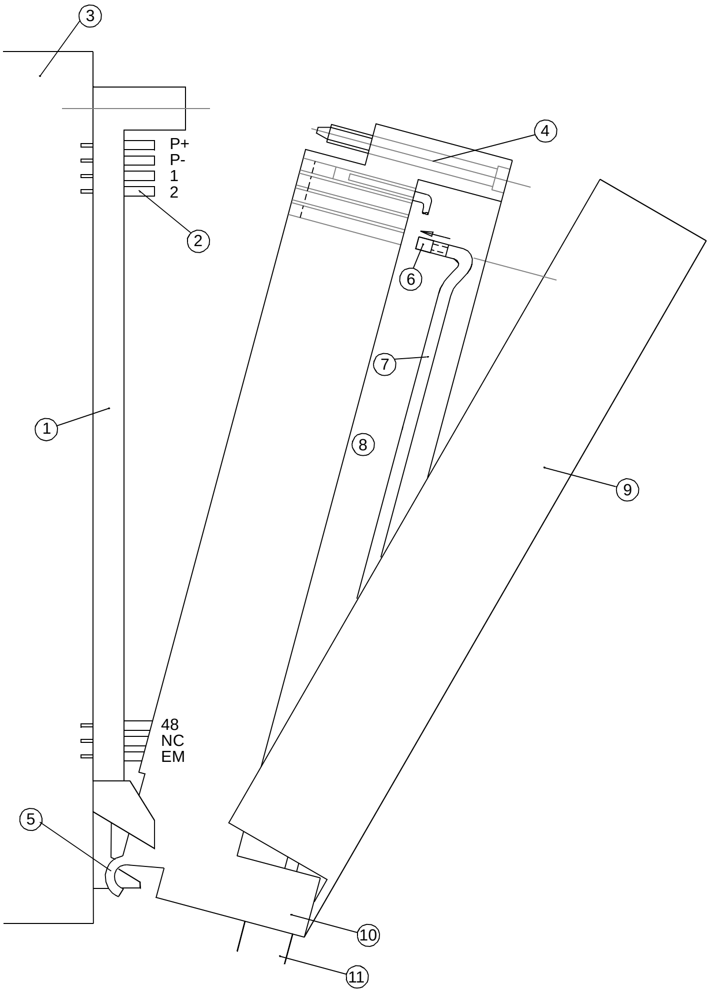
The designation of the process connectors with prefabricated cable are TK630 and TK640. TK630 comprises a process connector type TF610 and an unshielded process cable. TK640 comprises a process connector TF610 and a shielded process cable. The connectors can be supplied with three different cable lengths of 3.0, 5.0, and 10.0 meters. The cables are connected to the process connector's crimp contacts and are clamped in the cable entrance of the connector by a nylon cable strap. The other end of the cable is simply cut off, that is, without any preparation.

As you can see from the specification below, the wires are numbered along their whole length, so that the cable can be cut to any length without losing the wire identification. The cable has 48 wires conforming to the following specification:

- AWG20, 48 x 0.56mm^2 gauge wires, each wire with seven strands of 0.32mm, flex class 5
- Black wire isolation
- Wire numbers: 1 - 48
- Shield connected to EM (only TK640)
- Wire identification: Each wire has its own number printed along the wire
- Color of sheathing: Grey RAL7035
- Cable flammability: UL-CL2
- Minimum bending radius: Approx. 5 x cable diameter
- Rated isolation voltage: 300 volt.

Table 2-3. Process Connectors and Cables

Description	Type
Process connector, screw terminals, maximum wire gauge 1.5 mm^2	TF620
Process connector with cable, 3.0 meters, wire gauge 0.56 mm^2, unshielded	TK630V025
Process connector with cable, 5 meters, wire gauge 0.56 mm^2, unshielded	TK630V050
Process connector with cable, 10 meters, wire gauge 0.56 mm^2, unshielded	TK630V110
Process connector with cable, 3.0 meters, wire gauge 0.56 mm^2, shielded	TK640V030
Process connector with cable, 5 meters, wire gauge 0.56 mm^2, shielded	TK640V050
Process connector with cable, 10 meters, wire gauge 0.56 mm^2, shielded	TK640V110



① Multipoint connector plug (part of module)
② Blade contact
③ PC board of the I/O module
④ Fixing screw for multipoint connector
⑤ Hook
⑥ Junior timer contact
⑦ Process cables
⑧ Space for process cables
⑨ Cover
⑩ Pivot
⑪ Process cable

Figure 2-27. Process Connector with Crimp Terminals

Information on the Modular Front, Tag Fields for I/O Signals

You can find the following basic information on the front of the module (see also Figure 2-28):

- FAULT, next to the red LED
- RUN, next to the green LED
- Type designation at the bottom.

In addition to this basic information, further explanation about the module may be noted on a paper strip attached to the front door. The paper strip is covered with a transparent lid to prevent smudging.

There is a standard preprinted strip for each module. On it, the channel numbers are printed at the same height as the corresponding LED, making it easy to find the signal belonging to a particular channel.

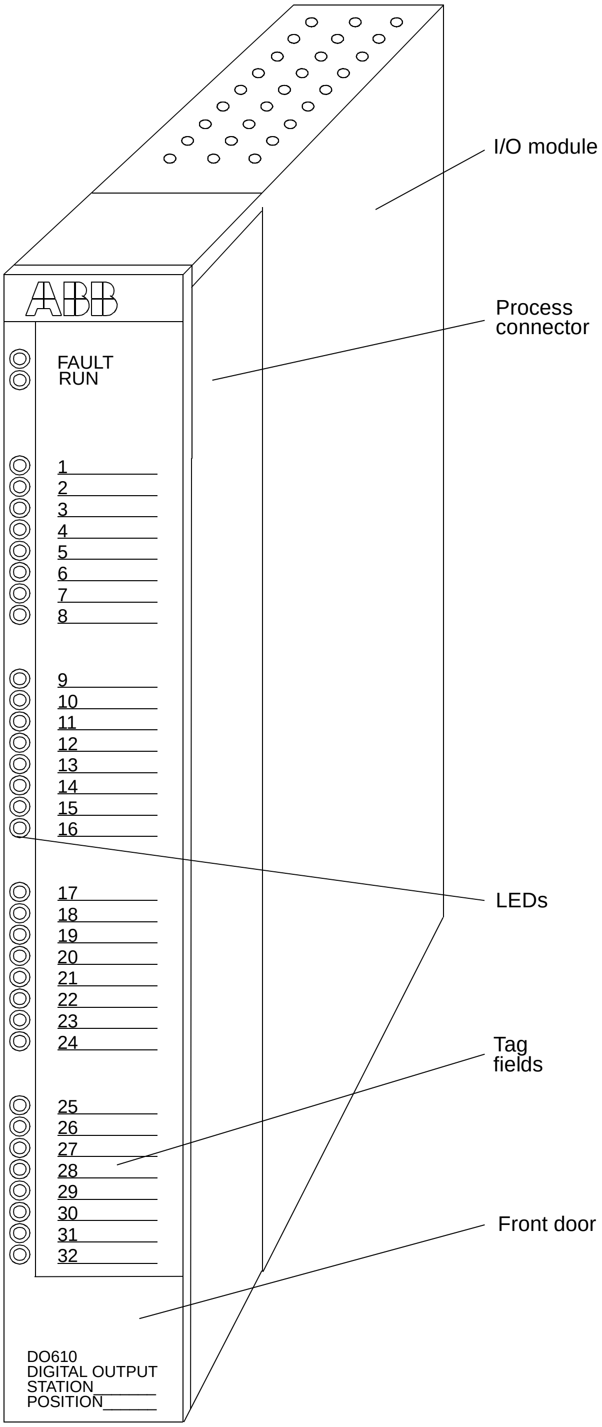


Figure 2-28. I/O Module with Front Door Closed

Information on the Modular Front, Connection Diagram

There is a standard scheme for allocating available process connector terminals to process signals. To simplify wiring the I/O system during installation, a connection diagram is engraved on the inside of the module front door. The diagram shows schematics, the process power supplies, and the relationship between process channels and connector terminals (UP, ZP, and channel/terminal number).

The diagram also shows any internal connections there may be between pins as well as examples of how to connect sensors, actuators, and so on. Apart from the connection diagram, the type designation of the module and a short explanation of its function are engraved on the inside of the front door. The terminal designations on the inside of the front door have the same spacing as the terminals of the process connector, thereby simplifying wiring and tracing connections.

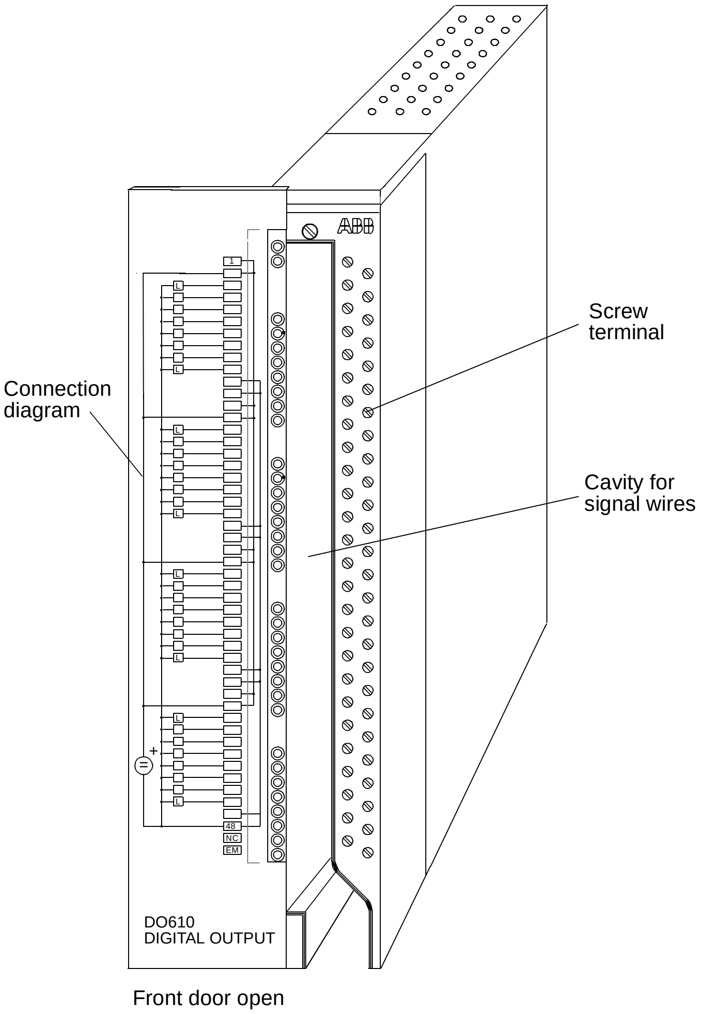


Figure 2-29. I/O Module with Front Door Open

2.2.14.2 Assembly

General

S600 modules and terminal units are normally factory assembled. For information regarding the location of equipment, see the actual delivery documentation. Assembly drawings, for example, also give the cross-reference between the following structures:

- Physical location of modules (position of modules in subrack) and terminal units
- Functional item designation of modules and signal channels.

The functional item designation, for example, AI1, and the position of a S600 module are hard related to each other. That means, for example analogue input module with functional item designation AI1 must be inserted at a certain position in the subrack. The relation to the position of the modules in the subrack is determined by the DB part of the application program.

Initially, standard location is followed, see Section 2.1.4, Standard Layout and Disposition of Cabinets. Customized layout is possible whenever applicable.

Reorganization of modules and terminal units is "theoretically" possible. A module position can be changed if the specified position is also changed in the DB part of the application program.

The question is, are there sufficient cable lengths to do the work.
A reorganization also calls for changing the documentation of the equipment.

Subracks

The subrack and cable duct assembly for the Advant Controller 110 will fit in a cabinet with a 19-inch rack conforming to IEC 297 - 1. The design is not confined to any particular cabinet and the minimum size is determined by the number of cables and marshalling.

There are two types of subracks, the basic subrack RF615 and the extension subrack RF620 (for more information see below).

The two subracks, RF615 and RF620, have the same dimensions. They have a width of 482 mm, which conforms to the 19-inch standard, and a depth of 325 mm, so you can install them in a cabinet 400 mm deep (internal depth not less than 330 mm). The height of the subracks themselves is 269 mm. The cable duct RC610 adds a further 100 mm to the height. In order to insert and withdraw I/O modules, a minimum space of 120 mm above the subrack is required. You should also leave a space of 120 mm below the subrack for ventilation purposes.

The RF615 and RF620 subracks are designed for installation one above the other. To install them one above the other, leave a 120 mm space between the two subracks, in addition to the spaces above the upper one and below the lower one. The resulting total height requirement is 1100 mm. All cables and mounting accessories are designed for subracks installed one above the other. Side-by-side or back-to-back mounting is not possible.

For more information about dimensions see Section 3.2.9, Mechanics.

Basic Subrack RF615

The RF615 is the primary subrack to use in a station. It has dedicated positions for a central processing unit (CPU) PM632, PM633, or PM634 and a communication interface CI626 (communication with the Advant Fieldbus 100) or a bus extender CI615. A code switch for setting the station address is located on the left-hand side of the basic subrack. The subrack has 10 positions, so it can accommodate a CPU PM632 or a bus extender CI610 (position 1) and nine I/O modules (maximum configuration). A 25-pole sub-D bus connector for an extension subrack is also located on the left-hand side of the basic subrack. On the right-hand side, there are four terminals (USA/ZD, USB/ZD) for the 24 VDC station voltage power supply.

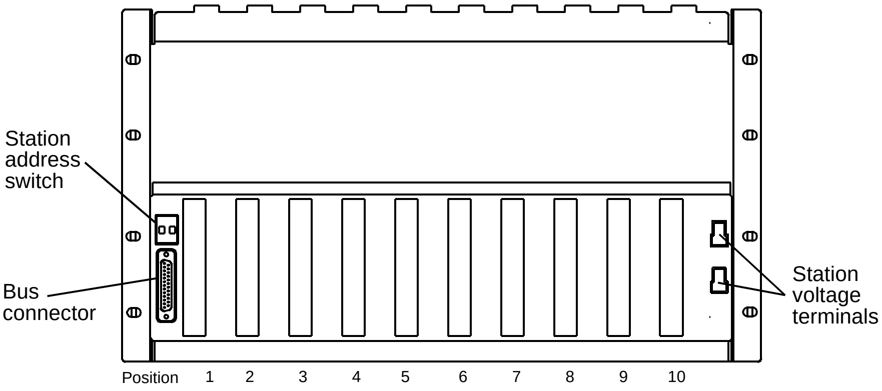


Figure 2-30. Basic Subrack RF615

Position 1:	CPU PM632, PM633, or PM634
Position 2-3:	Bus extender CI615
Position 4 - 9:	Other communication interfaces or I/O modules
Position 10:	Power supply module SA610.

Extension Subrack RF620

The RF620 is an optional extension subrack for I/O modules. It can only be used as such because it does not have dedicated positions for CPU, a communication interface, or a bus extender and it is not equipped with a code switch. On the left-hand side of the extension subrack, there is a 25-pole sub-D connector for the bus connection to a basic subrack.
As with the basic subrack, the extension subrack has 10 positions and 10 additional modules can be fitted. A base station comprising an RF615 and an RF620 can accommodate 19 modules.

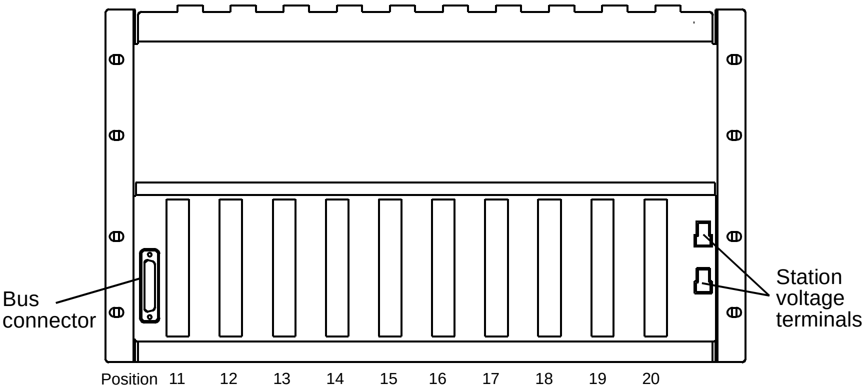

Bus connector
Station voltage terminals
Position 11 12 13 14 15 16 17 18 19 20

Figure 2-31. Extension Subrack RF620

Module

To mount a module on the subrack, hook it onto the upper front edge of the subrack, swing it down to the vertical position, and screw in the module fixing screw (see Figure 2-32). This screwing action ensures that the pins of the bus connector make in the proper sequence and that the module starts up correctly. The mechanical connection to the subrack grounds the module enclosure and provides EMC performance.

The process connector and the cables to the module are covered by a front door (see Figure 2-29).

Enclosure protection class of the Advant Controller 110 modules: IP 20.

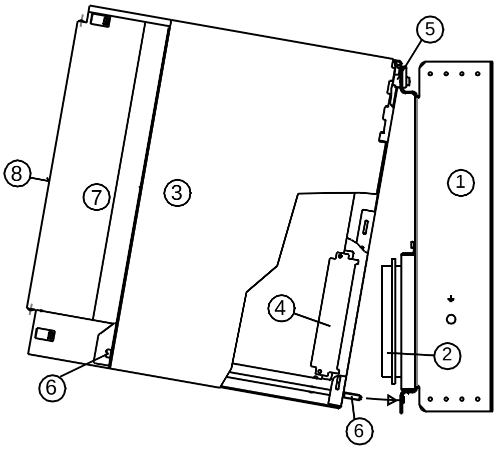


Figure 2-32. Module Fixing Screw When Mounting on Subrack

1) Subrack
2) Bus connector subrack
3) Module
4) Bus connector module
5) Hook
6) Module fixing screw
7) Space for process connector
8) Front of module

Submodule Carrier and Submodule

Submodule carriers are modules which fit the controller subrack only.
Carrier modules have no complete function. A carrier module has slots for specialized submodules.

You can obtain the desired functionality by mounting submodules into the carrier module. This is illustrated in Figure 2-33.

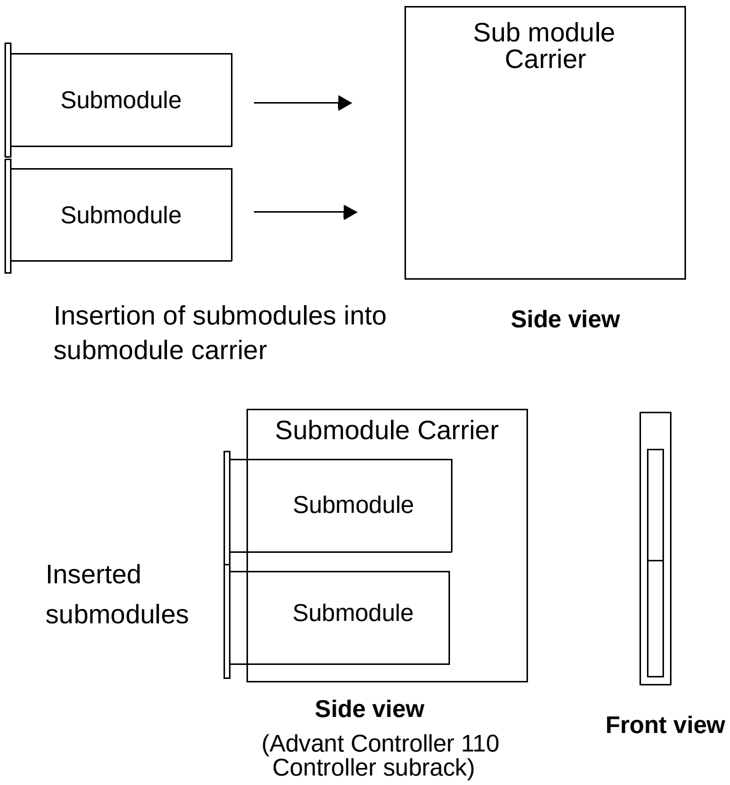


Figure 2-33. Carrier Module and Submodule Mechanics

One submodule carrier usually houses two submodules.

In principle, the one submodule is independent of the other submodule. This means you can insert, start, stop, and remove the one submodule without affecting the other submodule.

The submodule carrier is a single point of failure. Damaging the carrier module may affect one or both submodules. Replacing the carrier module, however, obviously affects both submodules.

Mechanically, any submodule fits into any submodule position on Advant Controller 110. The software does not, however, necessarily support all combinations.

Process Connectors

You can mount the process connector socket on the front of the module by hooking it into the lower edge of the module and swinging it upwards towards the module until the fixing screw engages and can be tightened. As with the module fixing screw, this action also ensures a proper start-up sequence, since the making order of the last two contacts is used to determine whether or not the process connector is mounted.

Two types of process connectors are available (see Figure 2-26 and Figure 2-27):

- Screw-type terminals (48 process signals, one spare, one chassis ground)
- Crimp-on-snap-in terminals (48 process signals, one spare, one chassis ground).

2.2.14.3 Electric Installation

Process Signals

Process signals are connected to the connection units according to site installation drawings supported by:

- Assembly drawings enclosed at delivery
- Terminal diagram forms enclosed at delivery
- Connection examples in *S600 I/O Hardware Reference Manual*.

The following instructions apply:

- Cable routing in cabinets, see Section 2.2.8, Cable Routing in Cabinets
- Grounding of cable shields, see Section 2.2.7, Grounding
- Grounding of process signals, see Section 2.2.7, Grounding.

Regarding cable selection, external cable routing, and so on, see general information in *Interference-free Electronics Design and Applications*.
A carefully accomplished electric installation is the basis of future interference-free operation.

2.2.14.4 Preparation for Start-up

Check of the External Wiring

Judge the level of workmanship case by case. The result determines the need to thoroughly check all connections before the system is powered up.
You can, of course, check with a buzzer or similar device that the external wiring to the process equipment is correct and that all conductors are intact.
Without activating the control equipment, you can also check that transducers and actuators (including all process wiring) function correctly. This makes it necessary to connect voltage to these units and develop suitable checking methods, which are time-consuming activities.

An alternative method is to make an integrated check of the process equipment and wiring and the corresponding controller function, which can be accomplished with a circuit-by-circuit procedure. Preferably, the controller is loaded with an application program. The DB part of the application program is then used as one checkpoint. Status/values can be read and control signals to process objects can be simulated by an engineering station.

CAUTION

When you use a somewhat tougher method, be aware of the risk of “accidents.” Short-circuiting and over-voltage can damage a limited part of the equipment, for example, a process I/O module.

2.2.15 S800 I/O

S800 I/O modules are normally delivered separately, to be erected in suitable cabinetry on site. The necessary communication modules and modems are assembled in the controller cabinet.

For information regarding the location of this equipment, see the actual delivery documentation. For other information, including all questions of installation, see the separate S800 I/O documentation: *Advant Fieldbus 100 User's Guide, S800 I/O User's Guide*

Preparation for Start-up

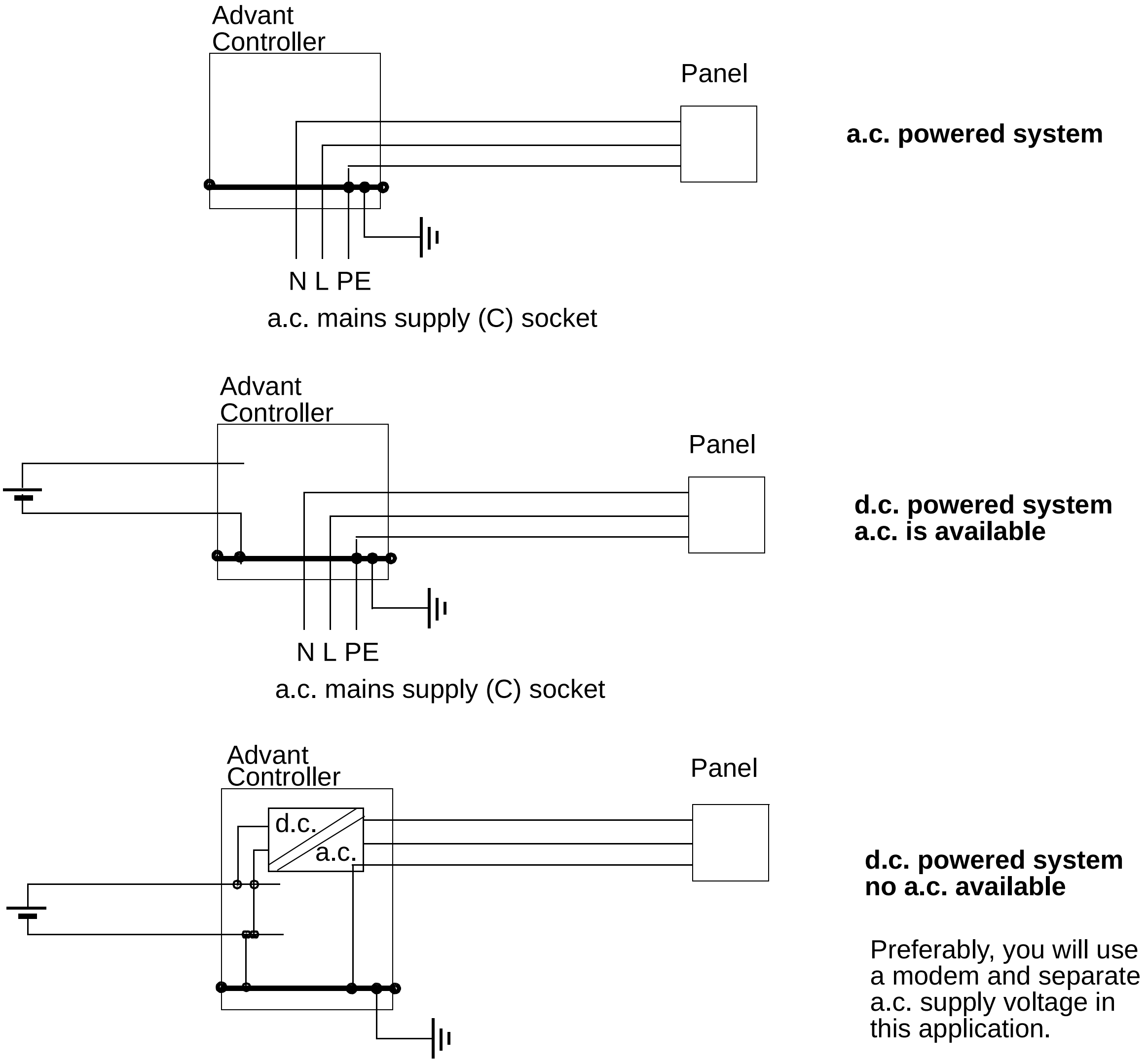
The general information given for a check of external wiring in Section 2.2.14, S600 I/O apply.

2.2.16 Peripheral Units

Power Supply

If you do not use a modem when communicating with a panel, you must take an a.c. voltage supply with a protected earth (PE) from the Advant Controller cabinet, that is, it is not acceptable to use the closest or otherwise most convenient supply receptacle.

Make the connection as shown in Figure 2-34. The significant aspect is that the peripheral unit should be grounded in the controller protective earth.



Preferably, you will use a modem and separate a.c. supply voltage in this application.

Figure 2-34. Supply of Peripheral Unit Without Modem

You are directed to always check that the utilized a.c. power supply meets the quality requirements of the peripheral unit, for example, the class of the network.

Take into consideration the extra load caused by any peripheral unit:

- When an intermediate isolating transformer is used in the cabinet to convert a two-phase network to a single-phase network
- From a fusing viewpoint.

Given the above rules, you can use any spare power outlet in the cabinet or you can arrange for an additional branching socket.

2.2.17 Communication

Refer to the following separate documentation:

- User's guide for the actual communication link.
- Assembly drawings, terminal diagram forms, and so on, enclosed at delivery of the Advant Controller. These show you the location of the hardware.

The following instructions apply:

- Cable routing in cabinets, see Section 2.2.8, Cable Routing in Cabinets.
- Grounding of cable shields, see Section 2.2.7, Grounding.

Regarding cable selection, external cable routing, and so on, see general information in *Interference-free Electronics Design and Applications*.
A carefully accomplished electric installation is the basis of future interference-free operation.

2.2.18 Engineering Station

The following apply to an engineering station type Advant Station 100 Series Engineering Station when connected directly to the Advant Controller 110.

Electric Installation (including Power Supply)

Plug the communication cable enclosed with the engineering station into the connector CH1 on the processor module front.

From the viewpoint of the Advant Controller, there are no restrictions on the mains power supply of the engineering station, for example, no requirement of earthing and same supply, and so on. The controller and the engineering station are galvanically isolated from each other by the serial communication interface.

2.2.19 Checklists

In the setup instructions, you are occasionally referred to a separate document, *Interference-free Electronics Design and Applications*.
The following checklist is a summary of important information addressed to the actual Advant Controller 110.

2.2.19.1 Grounding Philosophy, Earthing Line System

Table 2-4. Grounding Philosophy, Earthing Line System

Item	Concerning	Action
Grounding philosophy	Ground system	Grounding only to power earth line network. Only one ground system. No exceptions.
Earth line system	Design	The earth line system of the installation must be carefully installed and must incorporate the switchgear.

2.2.19.2 Process Cabling, Shielding, Grounding, Maximum Length

Table 2-5. Process Cabling, Shielding, Grounding, max. Length

Item	Concerning	Action
Cables	Prescribed type	Communication cables Pulse transducer cables Shielded for AI ≥12 bit and for Low level AI (Pt, thermocouple) Same signal types in same cable (low level/ d.c./a.c./ communication/power supply) Signal wire and return wire in same cable
Shielding: Single shield	Grounding: AI, AO, DI, DO, Modem TC562	Same position as signal circuit
	Grounding: Communications pulse transducers	At both ends
Shielding: Double shield	Grounding:	
	Outer shield	Both ends
	Inner shield	As signal circuits
Cable without shield	Grounding	All signal circuits grounded at the same end
a.c. digital inputs 120 V/230 V	Max. cable length	Approx.: 115 V - 230 m 230 V - 115m
Shield connections in radio-proof cabinet	Connection	Cable shields which are grounded in the cabinet must be immediately grounded directly or via capacitor when they enter the cabinet. (See separate instructions.)
Shielded cables not grounded in the radio-proof cabinet	Connection	Capacitive decoupling is to be used in the cabinet. Or a cable with double shield can be used where the outer shield is grounded in the cabinet.

2.2.19.3 Supply

Table 2-6. Supply

Item	Concerning	Action
a.c. Mains	Connection in cabinet	Phase (**check for correct voltage)** Return Protective earth (if distributed) **Note:** There must be no breaks in the protective earth line before the connection to the PE terminal.
	Fuse	In phase (phases)
	Connection of network:	No unsuppressed load on same finale circuit from distribution box
	Using of interference-sensitive power supply units not manufactured by ABB	Special isolation transformer for electronics supply must be used
	Internal distribution	Incoming power supply (120 V/230 V) must be separated from other cables by 5 cm or more
d.c. (floating battery)	Earthing, supply	Negative pole to PE terminal of cabinet directly at entry to cabinet.
d.c. (earthed battery)	Connection	Via d.c./d.c. converter
Subrack supply	Max. power output	< 90% of stabilizer capacity

2.2.19.4 Lightning Protection

Table 2-7. Lightning Protection

Item	Concerning	Action
Lightning protection		Actions are compulsory for all circuits in: Overhead lines Cables above ground Cables that leave the general earth line network

2.2.19.5 Subrack, Connection, Module

Table 2-8. Subrack, Connection, Module

Item	Concerning	Action
Connection	Quality	Only correctly made, screwed or clamped, connections are approved. Note: Inspected and approved tools must be used.
Modules	Variant reference	Check for lowest revision approved variant to be used for the equipment and use replacement of the same or higher revision number. This item is mainly relevant to maintenance and use of spare parts.
Modules	Assembly	Check that all units located in subracks are properly inserted.
Analog input modules	Full accuracy in the frequency range	Check data sheet in *S600 I/O Hardware Reference Manual*

2.2.19.6 Cabinet, Internal Cables

Table 2-9. Cabinets, Internal Cables

Item	Concerning	Action
Metallic door with glass window	Shielding	Interference immunity for the particular frequency which will be used, must be verified by a relevant walkie-talkie. **Not** allowed within EEC, EFTA. Not a CE-marked design.
Row of cabinets	Electrical connection (grounding)	Through short 35 mm^2 copper conductors or horizontal copper rail joining the PE terminals in each cabinet.
Cabinet parts (plates)	All parts electrically connected to each other and to the copper bar	R <100 mΩ
	Divided cabinets	Connection with special screws and nut bars
Earthing in cabinet	Design	Only a single grounding system for Advant OCS equipment **NO EXCEPTIONS**
Lighting	At maintenance	Only by filament lamp

Table 2-9. Cabinets, Internal Cables (Continued)

Item	Concerning	Action
Temperature in cabinet	Max. permitted temperature for continued operation.	Max. permitted temperature for continued operation in cabinet is 55°C. Measured just above the subracks. If this value is exceeded the number of circuit boards must be reduced.
Radio emission	Emission	Where EN or FCC requirements must be met, only radio-proof cabinet is adequate.
Shielded cable	Design	Communication, pulse transducers, and analog modules must be shielded up to the front connector
Internal cables	Routing	See: Section 2.2.8, Cable Routing in Cabinets. Check that there is no tension in the wiring.

2.2.19.7 External Cables

When you are selecting suitable cables to use and when the cables are placed in the plant, be aware that there are some restrictions and rules to be followed which involve, among other things:

- The distance between Advant OCS cables and non-Advant OCS cables
- The routing of communication cables
- Mixing of signals and signal types within cables
- The need for shielded cables.

See the electrical installation rules given in the sections above and the general document *Interference-free Electronics Design and Applications*, which also gives examples of the available cables.

2.2.19.8 Communication, Communication Cables

Table 2-10. Communication, Communication Cables

Item	Concerning	Action
Communication cables with shield (not coaxial cables)	Electrical connection to chassis Max. permitted length	≤50 mm (1.9 inch.) (1) Max. specified length must not be exceeded
Coaxial communication cables	Electrical connection to chassis Max. length	Not to be directly earthed or earthed at one point only (1) Max. specified length must not be exceeded
Communication without modem	Routing of cables	More than 100 mm (3.9 inch.)away from other cables

(1) Special rules apply to a CE-marked design. Refer to Section 2.2.7.5, Grounding of Communication Cable Shields

2.2.19.9 Corrosive Gases

Table 2-11. Corrosive Gases

Gas		Value (max.)
Sulphur dioxide	SO_2	30 ppb
Hydrogen sulfides	H_2S	10 ppb
Nitric oxides	NO_X	30 ppb
Chlorine + hydrogen chlorides	$CL_2 + HCL$	10 ppb
Hydrogen fluorides	HF	10 ppb
Ammonia	NH_3	500 ppb
Ozone	O_3	5 ppb

NOTE

If corrosive gases appear in the air, the humidity must be less than 40%, the rate of change of humidity less than 0,1% unit/minimum, and the maximum temperature less than 40°C.

The copper corrosion is to be a maximum of 300 Å/28 days.

2.2.19.10 Miscellaneous

Table 2-12. Miscellaneous

Item	Concerning	Action
Relays and contactors in cabinets	Suppression	Cabling to non-suppressed inductive loads in Advant OCS cabinets must be kept more than 100 mm away from internal cables.
Analog inputs/outputs	Type	Correct type: For grounded transmitters/ actuators/loads the inputs/outputs must be differential or isolated.

2.2.20 Final Procedures Before Start-up

Remove all debris remaining from the work performed and clean off all grease and dirt. Check that no tools or assembly materials are left in the cabinets. Vacuum the cabinets.

2.3 Shut-down Procedures

Before power supply switch-on and start-up of the equipment, it is important that you know how to shut down in different situations. See below.

Necessary Outfit

No special kit needed.

2.3.1 Safety Regulations

The instructions given in Section 2.2.1, Safety Regulations are applicable in all situations when you work with an Advant Controller and associated equipment. Read the instructions carefully. One instruction is highlighted:

DANGER

Work with care when supply voltage is applied in the system.
The voltage in the cabinet can cause injury and can even kill a human being.

2.3.2 Controller and I/O

Emergency Shut-down

An emergency stop should always be available. Adapt it to local statutory regulations. This is an obligation of those responsible for the plant design and construction. The controller system does not supply this specially arranged function.

NOTE

Check the location of the emergency stop and use it in an emergency situation.

From an electrical and functional viewpoint, an emergency stop has the same consequences to the controller and attached equipment as a safety shut-down. See below.

Safety Shut-down

The controller and its S600 I/O mounted in a row of joined cabinets are, from the mains power supply viewpoint, an entity. Safety shut-down aimed at disconnecting the controller from the mains is carried out in two ways:

- As prescribed in the site planning section, Section 2.1.7, Power Supply and Fusing, there should be a common safety switch installed within 3 m from the cabinets.

  NOTE

  Check the location of the safety switch and use it when working with the equipment.

  The safety switch should shut down the power supply of not only the electronics system but also the adequate transducers and other process objects. In other words, a total power shut-down for the plant section controlled.
  Since the safety switch is a plant component, this document cannot stipulate and describe the design exactly. Check the plant documentation in this respect carefully.
  Instructions indicating the extent of the power supply shut-down should be attached to the safety switch.

- You can also create a selective power shut-down of the entire electronics system using the mains circuit breaker in the lower part of the cabinet where the controller subrack resides. The breaker is labeled S1.
  This circuit breaker sometimes also disconnects the field equipment supply for the plant.

  NOTE

  Sometimes exist several breakers. See Section 2.2.10, Power Supply Connection

Regardless of the shut-down method, the result and consequences are:

- Application program execution immediately stops.
- There is zero output to the process objects.
- Output relays are de-energized.
- The RAM, including system software and application program, is secured against loss of power by a supply of power from a battery backup.
- Important process values, for example, totalized flow values, register content, and so on, can be stored automatically if measures are taken when the application start program is designed.
- The system is ready for a restart. You perform a restart by operating the actual mains switch when the reason for the shut-down is resolved.
  The application start program also facilitates a different way to start up the application, depending on the time of power supply disconnection.

A note about the application of S600 I/O and distributed S800 I/O:

> If such an I/O system is powered from the central system (the mains distributed), then the instructions and consequences given above in connection to a shut-down are relevant.
> If, however, the S600 I/O system and the distributed S800 I/O system are powered by a separate mains, separate safety switch, and so on, then you must make a distinction between a “central” (S600 I/O) and “local” (S800 I/O) shut-down.

S600 I/O

A central shut-down causes the S600 I/O outputs to go to zero.
At local shut-down the S600 I/O outputs of the “central” CPU station are not disturbed.

S800 I/O

A central shut-down causes the S800 I/O outputs to **freeze** or go to **predefined** value, as specified at DB element for S800 I/O channel in the application program.
A local shut-down causes the S800 I/O outputs to go to zero.

Regarding the output behavior attached to S600 I/O and S800 I/O, be aware that zero output, and so on, is the designed state. It cannot be guaranteed under all conditions, for example, in the event of a failure.

Manual Stop

Besides the most drastic shut-down method—disconnecting the power supply—other methods of “stopping” the controller are available to you.

You can stop program execution as follows:

- Use the operator’s interface on the processor module front.
  - Set the start mode selector in STOP position.
  - Press the INIT button.
  - The result of this stop and its consequences are:
    The controller immediately **restarts** and application program execution will stop,
    the outputs are forced to zero,
    output relays are de-energized,
    there is a loss of already read process data.
    (To start the application program again, you have download and deblock it with the engineering tool or if it was saved in FPROM before just set the Start Mode selector in position AUTO or CLEAR and press INIT button again.)
- Use an engineering station connected to the controller.
  - Command Block Program
  - The result of this stop and its consequences are:
    Application program execution immediately **stops**,
    the outputs remain,
    there is no loss of process data (besides what is happening in the process in the meantime).
    (To start the application program again just deblock it with the engineering tool.)

Automatic Stop

For the sake of completeness, the main reasons for an automatic stop are listed below:

- Loss of power supply
- Fault in power supply
- Fault in processor module
- Other fatal error.

The result of an unintentional stop and its consequences are, from the viewpoint of design philosophy, the same as for a safety shut-down you get when pressing the INIT button (see above).

If the loss of power supply does not exceed the time the processor module can buffer its memory (by battery or internal capacitor) **and** the Start Mode selector is in AUTO position, the controller executes a warn start instead of cold start. In all other cases the controller will execute a cold start. The controller will stop if Start Mode selector is in STOP position. For more information about Start Mode selector and warm/cold start, see Section 2.4.2.3, Initialization.

However, when there is a fault involved, other behavior must be taken into account.

2.3.3 Peripheral Equipment

Shut-down of peripheral equipment, like a local operator station, is treated below from the viewpoint of power supply disconnection only.

Regardless of whether the peripheral equipment is powered common to the controller or from a separate mains, you can shut down by disconnecting the mains whenever necessary.
Any faults or disturbances that may occur are local to the peripheral equipment only, for example, a missing printout.
You can restart by switching on the power supply whenever you like with respect to the controller function. The peripheral equipment is self-initialized.

2.4 Start-up Procedures

Activities up through “ready for application program loading” are described in this section. This includes power-up and the first definition/configuration of the system resources.
A visible result of the start-up procedures is that all red LEDs on module fronts are turned off and all green LEDs are turned on.

Necessary Outfit

The following kit is a minimum requirement:

- Ordinary hand tools
- Universal instrument, for example, digital multimeter
- Test leads with 4 mm banana contacts and reducer contacts for a 2 mm test jack
- Necessary parts of the documentation listed in Section 1.3, How to Use This Book
- Specific documentation enclosed at delivery, drawings, and so on
- Advant Station 100 Series Engineering Station.

2.4.1 Safety Regulations

The instructions given in Section 2.2.1, Safety Regulations are applicable in all situations when you work with an Advant Controller and associated equipment. Read the instructions carefully. One instruction is highlighted:

DANGER

Work with care when supply voltage is applied in the system.
The voltage in the cabinet can cause injury and can even kill a human being.

2.4.2 Controller and I/O

Conditions given by "Setup"

If you finish the setup activities by using the checklists given in Section 2.2.19, Checklists, the equipment is almost ready for start. Read the following security information first.

Measures by Security Means

Power-up of a controller and I/O presents a small but real risk of spurious output signals to the process due to a faulty hardware module.
Since this risk is very small, a general safe method, for example, extraction of all output I/O hardware during the first power-up, is not recommended. You are directed, however, to be careful on a case-by-case basis.

Always identify and isolate **critical process objects** in some way if the process is energized. Examples include:

- Opened safety switch
- Disconnected power supply
- Use of disconnectible terminal
- Withdrawn process connectors
- Unplugged terminal block
- Extracted output module.

Perform succeeding operations after power-up, including necessary tests, carefully.

2.4.2.1 Loading of AC 110 System Software and Its Options

On the front of the processor module PM632/PM633/PM634 "PL" will be displayed after power on if no system software is loaded. In this case you should load the system software and its options as described in this section.
The Advant Controller 110 system software and its options are stored in flash PROM on the PM632/PM633/PM634 module.
To load either system software or options to flash PROM, you need an Advant Station 100 Series Engineering Station and one of the diskette listed below:

• AC 110 BASE SW*2.2	Base system software
• AC 110 OPT1 SW*2.2	enables the extended PC element set
• AC 110 OPT2 SW*2.2	enables the MVI handler
• AC 110 OPT3 SW*2.2	enables event handling functions
• AC 110 OPT4 SW*2.2	enables the Modbus I driver
• AC 110 OPT5 SW*2.2	enables RCOM driver

The diskette contains:

- A loader program
- SETUP.PIF file to start the loader from Windows
- README.TXT file containing the latest information about the software
- Other required software.

Loading the System Software

Follow this procedure to load Advant Controller 110 system software:

1. Put the PM632/PM633/PM634 start mode switch into STOP position.
2. Press the INIT button of the PM632/PM633/PM634 module.
3. Wait until PM632/PM633/PM634's display shows "P3"
4. Connect the engineering station to the Advant Controller 110.
5. Start the engineering station.
6. Put the floppy disk containing the system software and the loader into the engineering station's drive A.
7. Start the Windows File Manager by double-clicking on its icon in the Main group. Select the drive A by clicking on its icon in the drive bar.
8. Find the SETUP.PIF file in the directory window of the File Manager. Start loading the new system software by double-clicking on the icon of the SETUP.PIF file.
9. When you have successfully loaded the Advant Controller 110 system software, it is indicated on the engineering station's screen.

If an error occurs during the download of the system software, repeat the above procedure.

Loading an Option

Follow this procedure to load an AC 110 system software:

1. Put the PM632/PM633/PM634 start mode switch into STOP position.
2. Press the INIT button of the PM632/PM633/PM634.
3. Wait until PM632/PM633/PM634's display shows "P3".
4. Connect the engineering station to the Advant Controller 110
5. Start the engineering station.
6. Put the floppy disk containing the system software and the loader into the engineering station's drive A.
7. Start the File Manager of Windows (or Windows for Workgroups) by double-clicking on its icon in the Main group.
   Select the drive A by clicking on its icon in the drive bar.
8. Find the SETUP.PIF file in the directory window of the File Manager. Start loading the new option by double-clicking on the icon of the SETUP.PIF file.
9. When you have successfully loaded the option, it is indicated on the engineering station's screen.

CAUTION

If the option loading process is interrupted by either pressing the INIT button or a power failure, the system software and any previously loaded options are erased and must be loaded again.
This state of PM632/PM633/PM634 is indicated on its display by showing "PL."

2.4.2.2 Power-up

If, for some reason, you desire a limited power-up, the minimum equipment necessary is a processor module PM632, PM633, or PM634.

The station voltage should be switched on in stages. First, check the mains supply and then the station voltage supply.

1. Check that the circuit breakers on the power switch units are switched off.
   There is one circuit breaker for mains A (labelled S1) and one for mains C (labelled F1).
   Redundancy adds another circuit breaker for mains B (labelled S1).
   Reflect the relevance of:
   - Power switch in the cabinet housing the controller subrack
   - Separate power switch in physically distributed cluster of S800 I/O modules
2. If SA610 power supply is used check that the on/off switch on the power supply module SA610 is in the "O" position.
3. Check that the Start Mode selector on Processor Module PM632, PM633, or PM634 is in the STOP position (see Section 2.4.2.3, Initialization).
4. Switch on the mains supply to the cabinet and check for correct mains voltage with a multimeter at the connection terminals on the power switch unit. See the terminal diagram form enclosed at delivery.
5. If SA610 power supply is used check that the LED (Uin) lights (indicating correct input voltage) on the SA610 power supply modules. Now switch on the power supply SA610 (on/off switch in the "I" position) and check that the LED (RUN) lights on the SA610 module.
6. Switch on the circuit breaker S1 on the power switch unit(s) in any order (mains A and B).
   Also switch on the miniature circuit breaker F1 for mains C.
   Several power switch and distribution units can exist in the controller cabinet or in adjacent I/O cabinets.
7. Check for the following positive indications of a successful power-up (see Figure 2-5):

– Distribution Unit SX554	green LED LIVE (24 V)
– Processor Module PM632, PM633, or PM634 (indicating working mode, no application loaded: P3 = Start Mode selector in STOP position PL = system software has to be loaded)	green LED RUN display ind. P3 or PL

   - Check that all the LEDs (FAULT and RUN) on communication modules and I/O modules are off.
8. There are also some negative indications, for example:

– S600 I/O modules (Indicating that the modules are defect).	red LED F (Fault)

9. The target system is now ready for loading system software or download of application program by connecting the engineering station directly to connector CH1 at the processor module.

10. Finally, set the start mode selector on Processor Module PM632, PM633, or PM634 in the AUTO or CLEAR position as required by your process.

If correct indications fail to appear, trace the fault in accordance with the instructions given in Section 5.3, Fault Finding and User Repair.

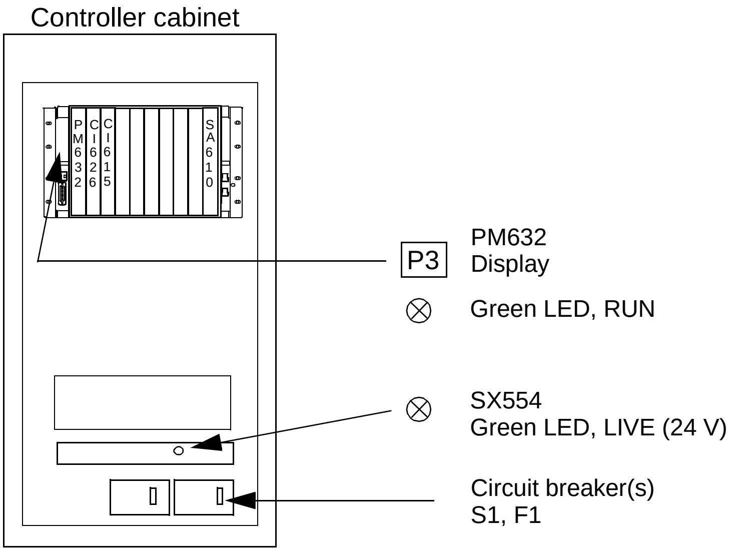


Figure 2-35. Power-up, Circuit Breakers, and Positive Indications

For information about cabinet configuration, see Appendix C, Cabinet Configuration.)

2.4.2.3 Initialization

In general, you can start an Advant Controller 110 in three different ways, as selected with the START MODE selector on the processor module front. These ways and applications are described in more detail in Chapter 4, Runtime Operation.

If possible, a restart is made automatically by the processor module after an error is detected.

The normal position of the START MODE selector is AUTO. At an interruption of the power supply, the system stores all the information necessary for restarting. This means the CPU performs a warm start with all variables intact when the power recovers.

The CLEAR position directs the CPU to start all programs from scratch.

With the switch in the STOP position the CPU does not restart any application program. Instead, it enters stop mode from where is must be restarted by the user.

The INIT push button initiates a CPU cold start independently from the start mode selector switch.

You can write control modules that are executed only after either cold start or warm start of the CPU. You can define how the process is to start with these control modules.
Start-up features and their application are described in *AMPL Configuration Advant Controller 100 Series Reference Manual*.

CLEAR - Cold Start

Initialization starts from the beginning and hardware and software are reset to an initial state. Application software is loaded from the internal PROM into the RAM.

The cold start is the reaction to a power failure, an error, or if the INIT button is pushed.

You can define a Control Module Header executed once at initialization after a cold start.
Set the C2 parameter of the CONTRM to 252 to do this.

Also, the PC elements below this CONTRM are executed only once after a cold start.

AUTO - Warm Start

The system software attempts to restart the application program after an error or a power failure occurs. In that case, the integrity of the loaded application program is checked. If a restart is possible, the system software continues executing the loaded application program where it was interrupted. This means that the timer (OSC-B, TON, …) and close loop controller with time elements (PI, PDP, …) continue their time measurement and keep their data during the warm start as they were before the warm start.

Also, data storing PC elements (SR, SR-D, …) keep their data during a warm start.

If the loaded application program is corrupted or the INIT button is pushed, cold start is executed.

You can define a Control Module Header which is executed once at initialization after warm start. Set the C2 parameter of the CONTRM to 254 to do this.

Also, the PC elements below this CONTRM are executed only once after warm start.

STOP

You can prevent the application program from starting if the start mode selector is in the stop position.

An error, which forces the CPU in AUTO or CLEAR mode to restart, leads to a system stop in STOP mode.

After power-up or after you push the INIT button, the processor module is initialized, but the application software is not loaded from internal PROM. The system software continues to operate to allow access to stored error messages by means of the Advant Station 100 Series Engineering Station.

DIAG

The PM633 and PM634 have an additional switch position.
When started with the switch in position DIAG, it only performs the initial processor diagnostics.
The results are shown on the processor module 7 segment display.

To restart the processor module again, put the switch in one of the other positions and press INIT.

2.4.2.4 Connection of Engineering Station

If it is not installed during the setup phase (see Section 2.2.18, Engineering Station), you can plug the engineering station communication cable into the connector CH1 on the Processor Module PM632, PM633, or PM634 front at any time.

Work with the engineering station is supported by adequate documentation.
For detailed information about different configuration activities using an engineering tool, see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

If the actual Advant Controller 110 is a node in an AF 100 network, you can connect the engineering station to any of the nodes included in the network. You can perform remote application programming and configuration in that way.

2.4.2.5 Configuration/Application Building

Configuration/application building is not part of the installation work described here. It is regarded as a separate activity and is treated in Chapter 3, Configuration of this manual as well as in separate documentation, for example, *AMPL Configuration Advant Controller 100 Series Reference Manual.*

The configuration/application building ends up in an application program. Primarily, the application language AMPL is used during program design.
An application program for an Advant Controller 110 system consists of a DB part and a PC program. The DB part and PC program cannot be downloaded separately.

The following must be fulfilled before you can load an application program from the Advant Station 100 Series Engineering Station:

1. Create an Advant Controller 110 node with the correct node address on the engineering station.
2. Create a DB part on the engineering station.
3. Create a PC program on the engineering station.
4. Generate target code for the application program of this target by selecting the related menu point item on the engineering station.
5. Connect the engineering station to the Advant Controller 110.

You can now download the application program. Do Steps 1 - 4 only once; do Step 5 every time you download the application program.

If an application program is already created, for example, in an identical system which is already tested, a program copy can de loaded.

2.4.2.6 Summary of Controller Start-up and Verification of Start

The following summary is a basic “from scratch” step-by-step instruction explaining how to start up. Other working schedules exist, especially in connection to revisions and system enlargement. Refer to *AMPL Configuration Advant Controller 100 Series Reference Manual* for complete information.

1. Power up
   Set start mode to AUTO on processor module.
   Set power switch on.
   For indications which verify a successful power-up, see Section 2.4.2.3, Initialization.
2. Processor module indicates P4.
   (P4 = no application program loaded).
3. Execute command Target/Connect of FCB at your engineering station.
4. Processor module indicates P6.
   (P6 = engineering tool connected, on-line mode).
5. Download your application program.
   The modules are configured. The green LEDs of the configured modules are turned on.
6. Save your application program (in FPROM) of processor module.
7. Deblock your application program.
   The execution of your PC program starts.
   The system is now started and ready for operation.
8. Execute command Target/Disconnect of FCB at your engineering station.
9. Processor module indicates P1.
   (P1 = processor module is in operational mode, application program running)

WARNING

When the application program is started, the process to be controlled is influenced.

Indications of an operating system with a started application:

- Analog inputs
  A/D conversion is in progress.
- Analog outputs
  Output signals are produced by the executing PC program.
- Digital inputs
  The LEDs on I/O module fronts show the process status regardless of whether or not the PC program is executing.
- Digital outputs
  Output signals are produced by the executing PC program.
  Indicated by LEDs on I/O module fronts.

2.4.2.7 Installation of Battery for Backup of Memory

The battery is mounted in the front of the processor module PM632/PM633/PM634.
Just plug in the battery before you start the controller. This lithium battery will back up the internal RAM of the processor module, the real time clock, and the calendar.

You know that the battery backup is functioning when you see that the LED BATT OK on the processor module front lights. LED BATT OK indicates that the lithium battery on the front of the CPU is inserted and charged. This function is always enabled, independent of the setting of the attribute WITH_BAT of the DB element for PM632/PM633/PM634, which only enables or disables error report entries for battery supervision.

NOTE

The LED BAT OK is off when the voltage supply of the Advant Controller 110 is switched off.

When you plan to disconnect power for a longer period of time exceeding several weeks, disconnect the battery. This avoids total discharge of the battery. This lithium battery is not rechargeable. The back up time of a new battery is 20 weeks.

2.5 Product Verification

Since the test requirements vary considerably among different installations, the designer is responsible for determining the function requirements, the limits within which the function requirements are to apply and other parameters which apply in the installation.

Necessary Outfit

The following kit is a minimum requirement:

- Ordinary hand tools
- Universal instrument, for example, digital multimeter
- Test leads with 4 mm banana contacts and reducer contacts for a 2 mm test jack
- Necessary parts of the documentation listed in Section 1.5, Related Documentation
- Specific documentation enclosed at delivery, drawings, and so on
- Advant Station 100 Series Engineering Station.

In more complex installations, which include closed loop control, some additional test equipment may be necessary/practical at tuning:

- Recorder with at least two channels
- Access to an operator station facilitating object display trim curves and trend curves.

2.5.1 Safety Regulations

The instructions given in Section 2.2.1, Safety Regulations are applicable in all situations when you work with an Advant Controller and associated equipment. Read the instructions carefully. One instruction is highlighted:

DANGER

Work with care when supply voltage is applied in the system.
The voltage in the cabinet can cause injury and can even kill a human being.

2.5.2 Servicing Tool

Installation of an engineering station, the main servicing tool, is described in Section 2.4.2.4, Connection of Engineering Station. Detailed information for its use is given in separate documentation.

2.5.3 Commissioning

2.5.3.1 General

For a general description of how to set the controller in operation and start the execution of an application program, see Section 2.4.2.6, Summary of Controller Start-up and Verification of Start.
Below you can find general information on some function tests which you can perform to verify the product. Short notes on adequate facilities provided by the engineering station are also listed.
For a more detailed description, see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

2.5.3.2 Procedure

The application program is normally checked, one executing unit at a time. This is done by deblocking the complete PC program and successively deblocking the execution units, one after the other. You can, for example, check that a flow valve functions and then verify the start sequence for a pump motor, and so on.

After each sub-function is tested, a comprehensive function control is performed to verify that all execution units function together.

Finally, a full scale check of the complete installation is performed to verify that the program is in accordance with the plant specification.

2.5.3.3 Blocking and Deblocking of the PC Program

During a test of the application program, you can prevent the control system from affecting the process in two ways:

- By withdrawing the process connectors at the S600 I/O modules (or likely locations) to physically isolate output signals from the process
- By blocking the PC program execution with the help of certain commands of the Advant Station 100 Series Engineering Station.

Commands of the Advant Station 100 Series Engineering Station for blocking the PC program execution:

- Target/Block
  Blocking of the PC program execution. Outputs of I/O modules keep their actual values.
- Target/Deblock
  Deblocking of the PC program execution. Outputs of I/O modules will be updated according to PC program execution.

2.5.3.4 Test Facilities Provided by the Engineering Station

For a detailed list and detailed descriptions, see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

On-line Modification of Application Program

On-line configuration and programming is the modification of a user application program on an engineering station while the engineering station is connected to an Advant Controller 110 system. Modification in this case includes insertion and deletion of executable units or DB elements.

On-line configuration and programming is only possible by means of the Function Chart Builder running on an engineering station in *on-line mode*.

The Function Chart Builder is in on-line mode when it is connected to the related Advant Controller 110 target and when the same version of the application program is selected on both the engineering station and the Advant Controller 110 target.

CAUTION

Process equipment may be damaged!

The consequences of on-line modifications must be fully considered and understood before taking actions.

Using Function Chart Builder in on-line mode has some special effects:

- Modifications in the PC editor (tree representation or function chart representation) can be made within only one executable unit at a time. Before proceeding within another executable unit, perform the **Target | Load Application** command.
- Modification of the scheduling strategy of a control module (cyclic activation, activation at initialization, and so on) is not allowed.
- Modifications in the DB editor are not allowed if modifications have been made in the PC part without performing the **Target | Load Application** command.
- After leaving an editor with the **Target | Load Application** command, the modified executable unit or the modified DB element is converted to target code, downloaded to the Advant Controller 110 target, and switched to execution automatically.
- During on-line programming applications with sequences, if you insert a new STEP element or delete an old STEP element, the sequence is first executed once in RESET mode after on-line change.

For detailed description of windows, commands, and dialogs, see *Function Chart Builder User's Guide*.

Test Functions for PC Part

The test functions perform value displaying (monitoring) and value forcing.

These test functions are available in the Function Chart Builder running on the engineering station in *on-line mode* only.

The engineering station is in on-line mode when it is connected to the related Advant Controller 110 target and when the same version of the application program is selected on both the engineering station and the Advant Controller 110 target.

Test Functions for PC Part, Display and Forcing

Value display (monitoring) and forcing of PC terminals are parts of the test functions of the engineering station.

The Function Chart Builder presents the monitored and forced values in

- Function chart representation giving information about the states of local sections within an application
- Table representation collecting the variables distributed over the application.

When forcing PC terminals you should be aware of following danger:

CAUTION

Process equipment may be damaged!

The consequences of forcing values must be fully considered and understood before taking actions.

Be aware that force values on the target are valid only during being in the test function of the engineering station. When you leave the test functions on the engineering station, all the force values on the target will be cleared.

The force values are downloaded to the target system and linked to the related executable unit.

Loaded force values become active on the target system at the next execution of the related executable unit.

Forcing terminals is a temporary function. When you leave the test functions on the engineering station, all the force values on the target will be cleared.

The Function Chart Builder stores the marking of terminals to be forced and their values on the engineering station and they are available at the beginning of the next session.

NOTE

The values displayed on the engineering station are determined at the **end of the execution** of the related control module. In the following example, the display shows the value of the variable after being overwritten by a force value. The input terminal of the PC element MOVE at execution times is supported by the calculated output terminal of the AND element.

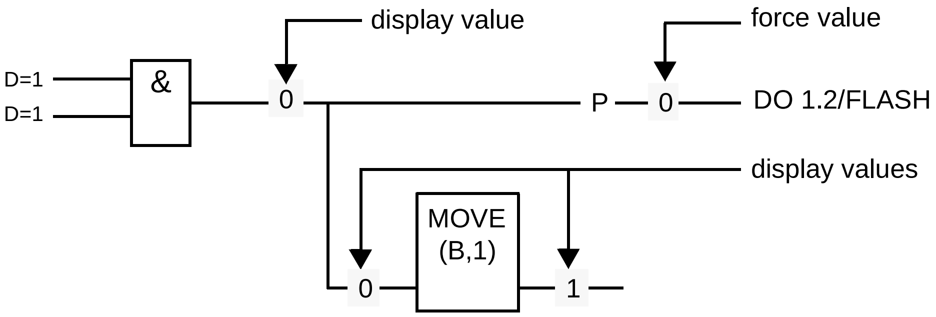


Figure 2-36. Example of Display and Force Values

2.5.3.5 Tuning of Feedback Control Loops

When feedback control functions are used in the Advant Controller system, select the optimum sampling time for the process concerned and set other feedback control parameters so that the feedback control becomes stable under varying loading conditions, and so on. This is described in separate documentation.

2.5.3.6 Check of Process Input/Output System

General

The process connectors are now inserted and the channels are tested one by one. The output channels are tested from the PC program to the actuators in the process and the input channels are tested from the transducers to the application software. In both cases, the operation of the hardware functions is observed on the signals on the modules and the operation of the software functions is observed on the screen of the Advant Station 100 Series Engineering Station.

It may be necessary to simulate digital and analog input signals which are normally generated by the process. Suitable methods to do this are:

- Digital inputs

  Activate the input by applying a voltage, corresponding to the rated input signal voltage, as close as possible to the process transducer, in order to test as much of the process wiring as possible. You can also generate a test input signal by operating transducers manually, for example, by actuating limit switches.

- Analog input signals

  Use a signal generator to generate analog signals. A simple test circuit to generate a voltage consists of a potentiometer connected across a suitable voltage source capable of producing a positive and a negative output. You need a current source capable of at least 20 mA to generate current signals. Analog test signals should also be injected as close as possible to the signal transducer to test as much as possible of the process wiring.

You can show on-line updating of input signal values on the Advant Station 100 Series Engineering Station in the function "Test."

For a detailed description of how to operate the function "Test," see *AMPL Configuration Advant Controller 100 Series Reference Manual* and *Function Chart Builder User's Guide.*

The following must be fulfilled before you can set I/O parameters or display them on the Advant Station 100 Series Engineering Station:

1. Create an "Advant Controller 110 target" on the engineering station.
2. Create the DB part, that is, the necessary DB elements for I/O modules and channels (DI, DO, AI, and so on).
3. Create a PC program.
4. Generate target code for the application program.
5. Connect the engineering station to the Advant Controller 110 and download the application program.
6. Start the application program on the Advant Controller 110.

Testing Input Signals

Test a digital input channel as shown in Figure 2-37. The procedure is very similar for analog signals (refer to Figure 2-38). Test digital and analog input channels as follows:

1. Select a PC element terminal connected to the related DB element in the Advant Station 100 Series Engineering Station function "Test."
2. Select the menu item for display on the Advant Station 100 Series Engineering Station.
3. Activate the signal input by activating the signal transducer or by simulating the signal.
4. Check that the corresponding yellow LED on the input module lights up (only digital modules). For analog inputs, measure the signal with a multimeter at the terminal of the process connector of the corresponding channel. Check that the change appears at the terminal "VALUE" of the DB element on the Advant Station 100 Series Engineering Station screen.
5. Switch the test signal for a digital input to logical "0" and check that the yellow LED on the input module extinguishes and that the signal at the "VALUE" terminal goes to "0."

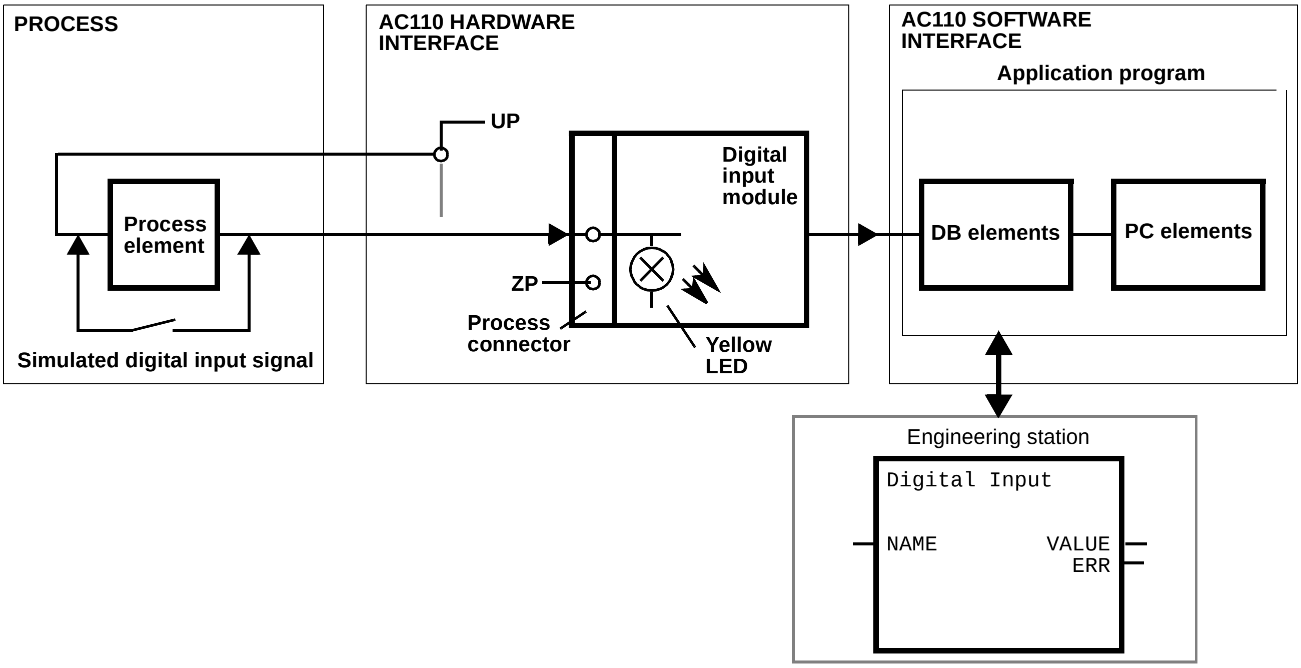


Figure 2-37. Testing Digital Input Signals

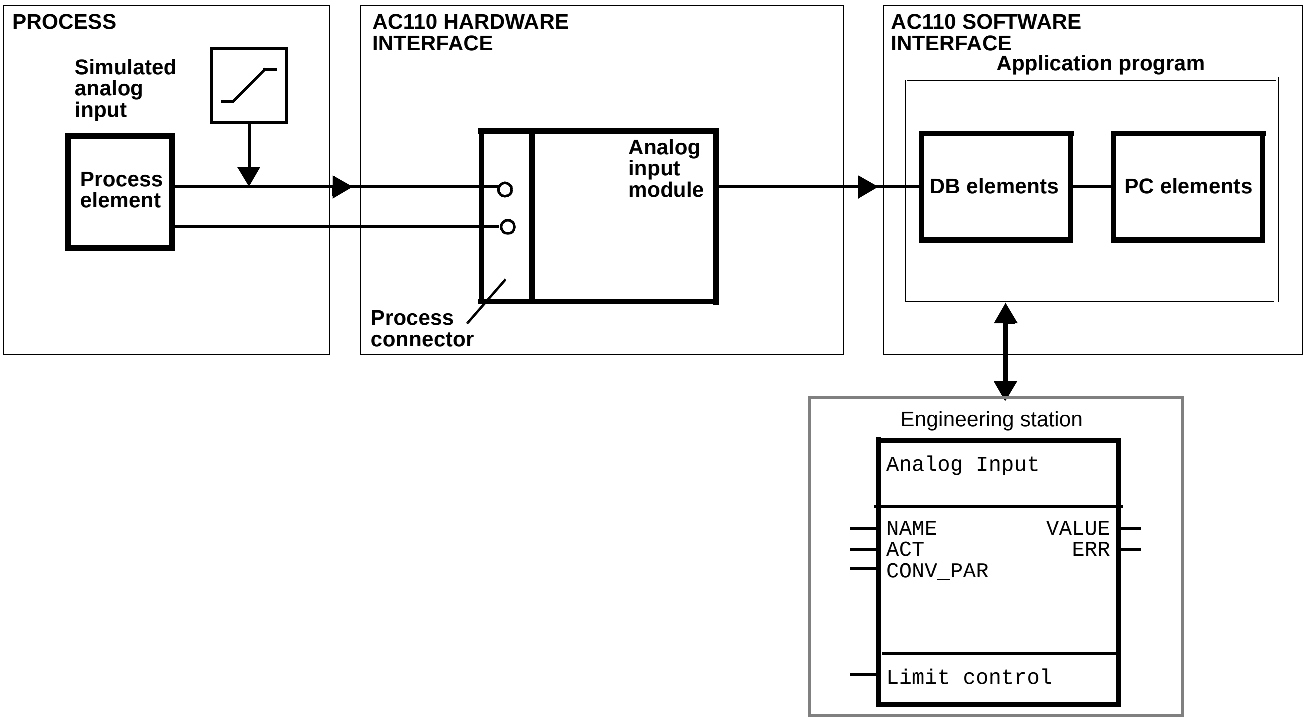


Figure 2-38. Testing Analog Input Signals

Testing Output Signals

Test a digital output channel as shown in Figure 2-39. The procedure is very similar for analog signals (refer to Figure 2-40). Test digital and analog output channels as follows:

1. Select a PC element terminal connected to the related DB element in the Advant Station 100 Series Engineering Station function "Test."
2. Select the menu item for forcing output signal values.
3. Select the "VALUE" terminal on the DB element and enter the desired output value.
4. Check that the corresponding yellow LED on the output module lights up (only digital modules). For analog outputs, measure the signal with a multimeter at the terminal of the process connector or at the actuator.
5. Reset the desired output value to a low value and check that the yellow LED on the module extinguishes and that the signal value changes.

NOTE

The yellow LEDs on the module DO610, which indicate the status, light only if the process voltage "UP" (that is, 24 V DC) is connected.

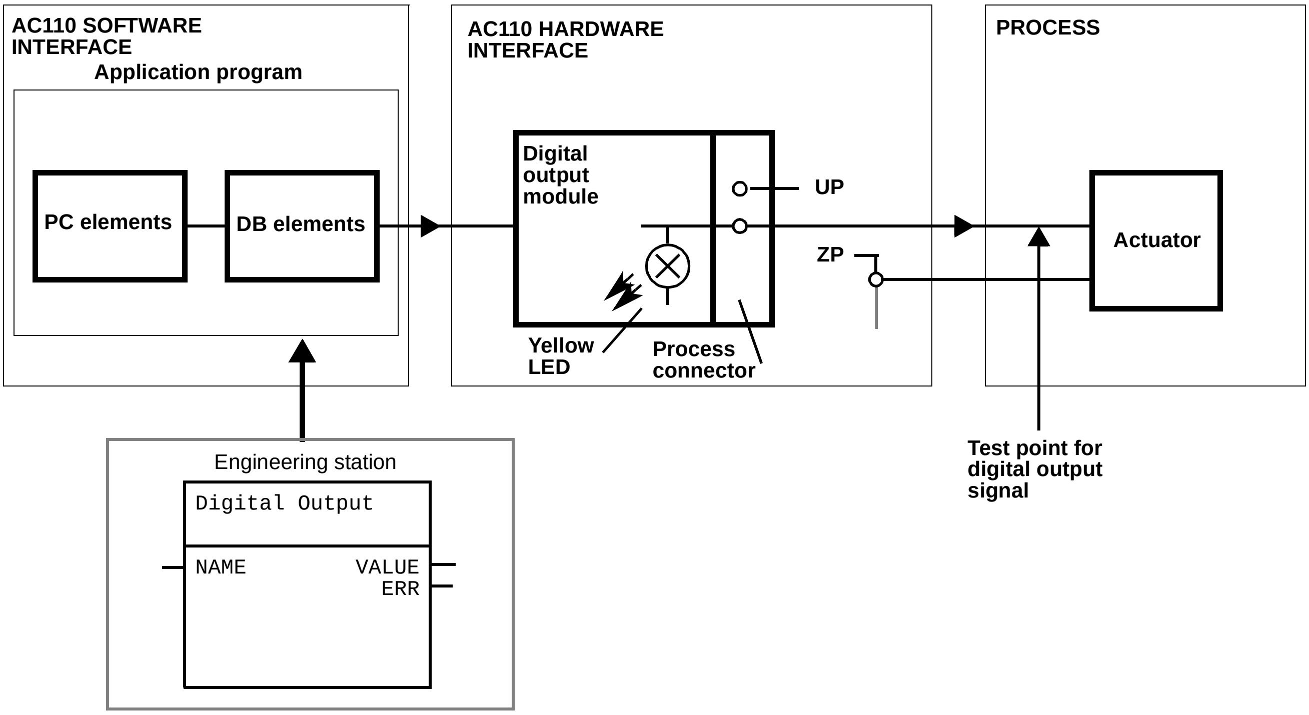


Figure 2-39. Testing Digital Output Signals

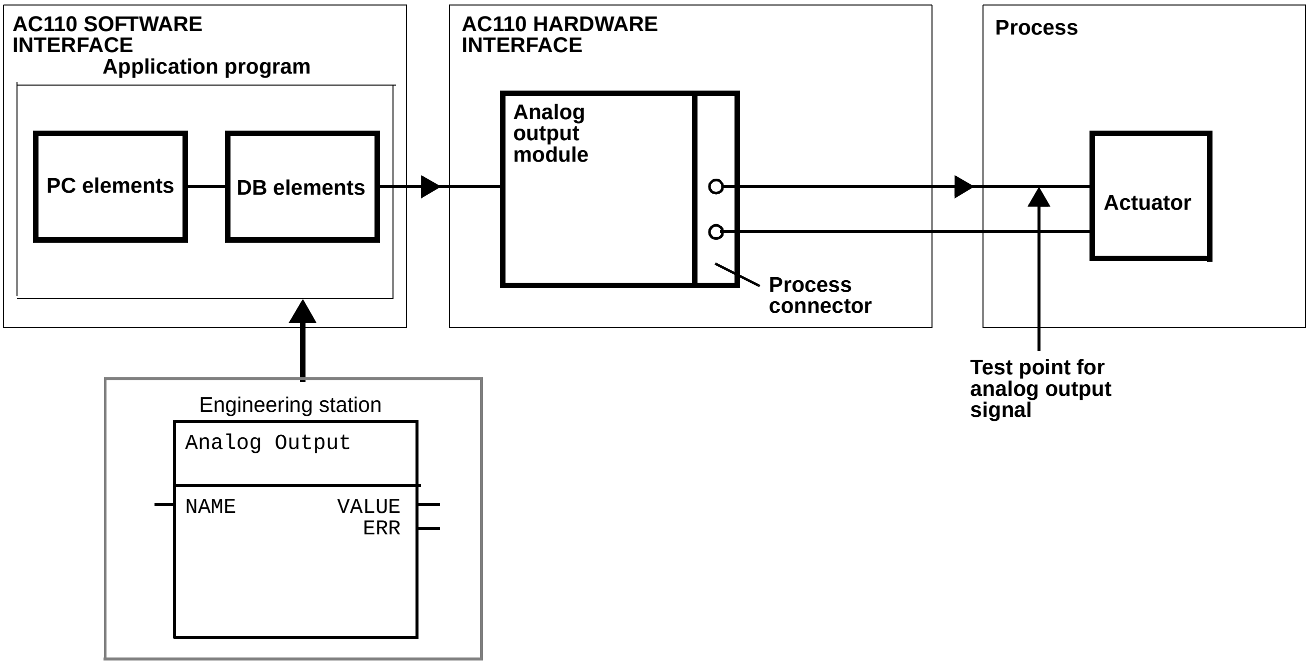


Figure 2-40. Testing Analog Output Signals

2.5.4 Final Control

When the control system testing is complete and the plant is functioning satisfactorily, take the following actions:

- Check that all modules are properly inserted in the subrack and that no screws are loose.
- Check that all terminal screws on process connectors and terminal units are properly tightened and that all grounding is effective.
- Check that all cable bushings are installed properly to avoid cable wear.
- Check that no tools or debris from cable installation remain in the cabinet. Clean the cabinet.
- Make a final listing of the DB and PC parts of the application program to obtain correct documentation of the system, including all tuning parameters.
- Generate source code of your final DB and PC program part and save it with Advant Station 100 Series Engineering Station, see *AMPL Configuration Advant Controller 100 Series Reference Manual*. You can generate your actual target code from this source code if it is necessary.

2.6 Implementation of Functions in Systems Already Operating

Enlargement of the system with additional functions differs from a "from-scratch installation." The main reason they differ is that the system is or has been in operation, which means that on-line/off-line aspects are important. The influence on the application program is also important. From these viewpoints, among other things, the most common additional functions are treated below.

Necessary Outfit

The following kit is normally a minimum requirement:

- Ordinary hand tools
- Universal instrument, for example, digital multimeter
- Test leads with 4 mm banana contacts and reducer contacts for a 2 mm test jack
- Necessary parts of the documentation listed in Section 1.5, Related Documentation
- Specific documentation enclosed at delivery, drawings, and so on
- Advant Station 100 Series Engineering Station.

In more complex installations, which include closed loop control, some additional test equipment may be necessary/practical at tuning:

- Recorder with at least two channels
- Access to an operator station facilitating object display trim curves and trend curves.

2.6.1 Servicing Tool

See Section 2.4.2.4, Connection of Engineering Station for a description of installing an engineering station, the main servicing tool. For detailed information about its use, see separate documentation.

2.6.2 Safety Regulations

The instructions given in Section 2.2.1, Safety Regulations are applicable in all situations when you work with an Advant Controller and associated equipment. Read the instructions carefully. One instruction is highlighted:

DANGER

Work with care when supply voltage is applied in the system.
The voltage in the cabinet can cause injury and can even kill a human being.

2.6.3 General Guidelines

Naturally, all design considerations given in Section 3.1, Considerations are also relevant to installation in a system already in operation. Among other things, you may want to reflect upon:

- Hardware, types, and location
- Restrictions in function combinations
- Software options needed to produce the additional application you desire, for example, software option OPT1 for additional PC elements.
- Interface to application program to be used
- CPU load
- Memory consumption
- Power supply requirement
- Heat dissipation.

Table 2-13 shows whether or not a function can be implemented on-line.

On-Line/Off-Line

On-line means that all work can be carried out while the controller is in full operation. Because of the risk of making manual mistakes in such handling, and the possible severe consequences to the process controlled, it is recommended that you use this on-line facility restrictively.
The best method of working:

The system is stopped and the voltage supply is disconnected when a new function is installed.

Disconnection of the mains supply may have impact on dynamic information stored in the application program. For example counter/register content, integrator content, and so on, could be lost. However the controller should manage mains supply interruptions not exceeding the time the battery can buffer and Start Mode selector is in position AUTO (warm start).

Source Code of Application Program

Before installing a new additional functions or new system software, generate source code of your application program (DB part and PC part).

The source code enables you to generate the "origin" target code of your application program if you want to cancel the changes you made. However you need only the source code in one case—when the compatibility of the target code is not guaranteed. This normally happens with new releases and not with revisions.

Summary of Aspects

Table 2-13. Implementation of Functions in Systems Already Operating

Function/Equipment	Enlargement/Addition	
	On-line	Off-line
System software		X
I/O module (S600 I/O)	X	
I/O extension subrack (S600 I/O)		X
Bus extension to S600 I/O station	X	
PROFIBUS-DP	X	
MasterFieldbus	X	
Advant Fieldbus	X	
RCOM	X	
Siemens 3964R	X	
MODBUS I	X	

2.6.4 Additional I/O Modules

Replacement of faulty modules is described in Chapter 5, Maintenance.

For a detailed description of the connection and use of an engineering station and different commands, see separate documentation, for example, *AMPL Configuration AC 100 Series Reference Manual*.

Preparation and Setup

I/O modules are normally grouped by type, so place the new module with modules of the same type, if possible. Note, however, that you must consider the power requirement and heat dissipation.

Route cables in accordance with the guidelines set forth in Section 2.2.8, Cable Routing in Cabinets.

Mount I/O functions in the following way:

1. Make a plan for the work to be done.
   - Read the General Guidelines above and apply the information.
   - Check for available spare position(s) in the subrack(s).
2. Make a source code of your application program (if not already available)
3. Switch off the supply voltage to the control system (recommendation).

NOTE

Remember that the control function of the system ceases and the process being controlled is affected.

4. Install the S600 I/O process connector with the wiring between process connector and the terminal unit/terminal blocks to which the process cables are connected.
5. Ensure that there is no tension in the wiring.
6. Insert the new module. Ensure that it is fully in place up to the hinge of the subrack. Tighten the module-securing screw.
7. Insert the process connector and tighten the connector screw.
8. Connect the process cables to the terminal unit/terminal blocks. Reflect upon all installation rules regarding cable routing and grounding.
   As an alternative, first make a functional verification when the process is not connected. Then connect.

Start-up

The start-up is carried out in different ways, depending on the main working mode, on-line or off-line.
If a module is **added on-line**, the additional I/O modules are put into operation as the adequate DB elements are created and the changed DB part of the application program is downloaded. The additional modules are taken into operation automatically and their green LEDs are switched on.

You can, of course, switch off the power supply during the installation work.
Then switch on the power supply, keeping the start mode selector on the processor module in the AUTO position. The system is restarted and in full operation apart from the additional module. The additional I/O modules are put into operation as the adequate DB elements are created and the changed DB part of the application program is downloaded.

If the module is **added off-line,** change your application program off-line, download and deblock it. The additional I/O modules are put into operation as the adequate DB elements are created

Perform the final stages, which include start of application programs, successively, especially those application programs which are affected by the additional I/O modules.

WARNING

When the application program is started, the process to be controlled is influenced.

Verification

Make functional tests, including process functions, applicable.

If correct indications fail to appear, trace the fault in accordance with instructions in Section 5.3, Fault Finding and User Repair.

2.6.5 Loading Additional System Software Options

For a detailed description of the connection and use of an engineering station and different load commands, see separate documentation, for example, *AMPL Configuration Advant Controller 100 Series Reference Manual*.

NOTE

> Loading an option leads to a restart of Advant Controller 110. You can choose the type of restart (cold start, warm start, stop) with the Start Mode selector at the front of the processor module PM632/PM633/PM634.

Follow this procedure to load an AC 110 system software option:

1. Connect the engineering station to the Advant Controller 110.
2. Start the engineering station.
3. Put the floppy disk containing the system software and the loader into the engineering station's drive A.
4. Start the File Manager of Windows (or Windows for Workgroups) by double-clicking on its icon in the Main group.
   Select the drive A by clicking on its icon in the drive bar.
5. Find the SETUP.PIF file in the directory window of the File Manager. Start loading the new option by double-clicking on the icon of the SETUP.PIF file.
6. When you have successfully loaded the option, it is indicated on the engineering station's screen.

CAUTION

> If the option loading process is interrupted by either pressing the INIT button or a power failure, the system software and any previously loaded options are erased and must be loaded again.

This state of PM632/PM633/PM634 is indicated on its display by showing "PL".

Chapter 3 Configuration

3.1 Considerations

This section tells you some of the things you need to think about during configuration and application building.
This follows the primary structure outlined in Section 1.8, Product Overview, however, some subsections have been added. The information is given as concisely as possible under the following headings, as relevant.

- Appropriate Hardware and Software
  What is necessary to achieve a function.
- Interface to Application Program
- Guidelines
  Typical information:
  - Location of hardware
  - Recommendations
  - Limitations.

For information on the possible number of instances, see Section 3.2, Capacity and Performance.

3.1.1 Product Structure

The product structure deals primarily with general functional modularization. In that context, questions regarding number of supported functions, possible combinations of functions, and so on, are relevant. For the answers to such questions, see Section 3.2, Capacity and Performance.

Regarding the realization of functions, note that the hardware structure and the software structure of the product differ. A functional option may require extra hardware, but the software is included in the Advant Controller 110 Base SW. Or an Advant Controller software option may support several functional options (each with dedicated hardware).

The following diagrams shows you the structure of the components of an Advant Controller 110 system on different levels.

3.1.1.1 System Structure

The Advant Controller 110 can communicate with other components of the Advant Open Control System (Advant OCS). Figure 3-2 shows the busses and links for connection.

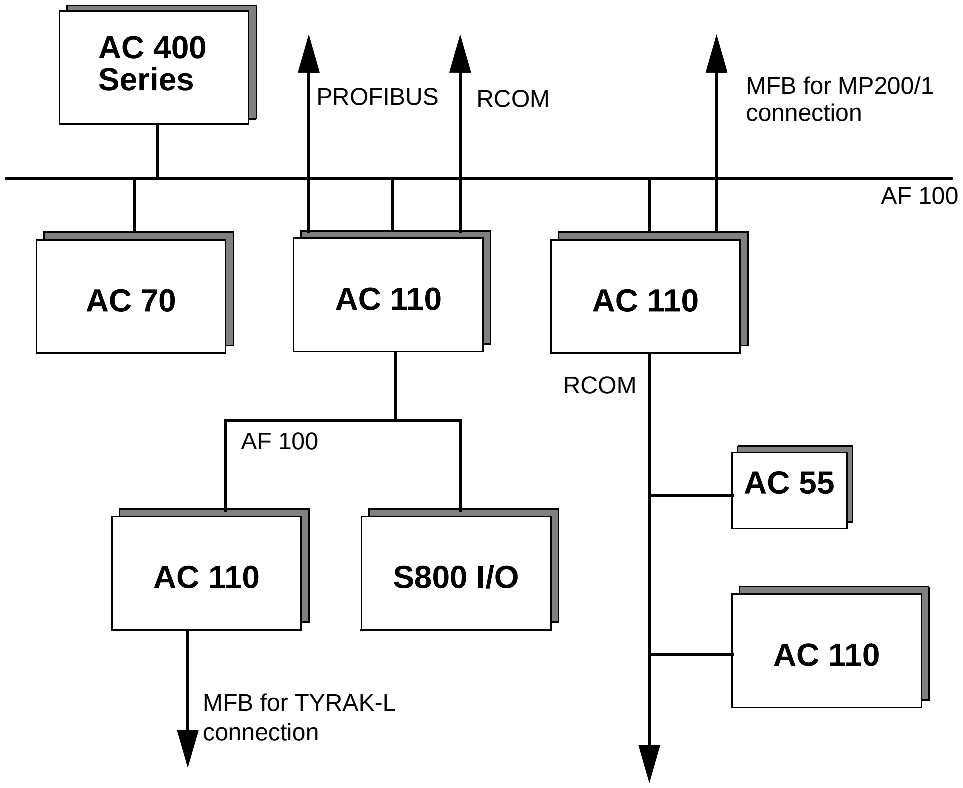


Figure 3-1. Example of Advant OCS System Structure with Advant Controller 110, Overview

3.1.1.2 Block Diagram

Figure 3-2 indicates broadly the functional relationship between main system utilities and how the hardware is structured. This is an example of a version of the Advant Controller 110.

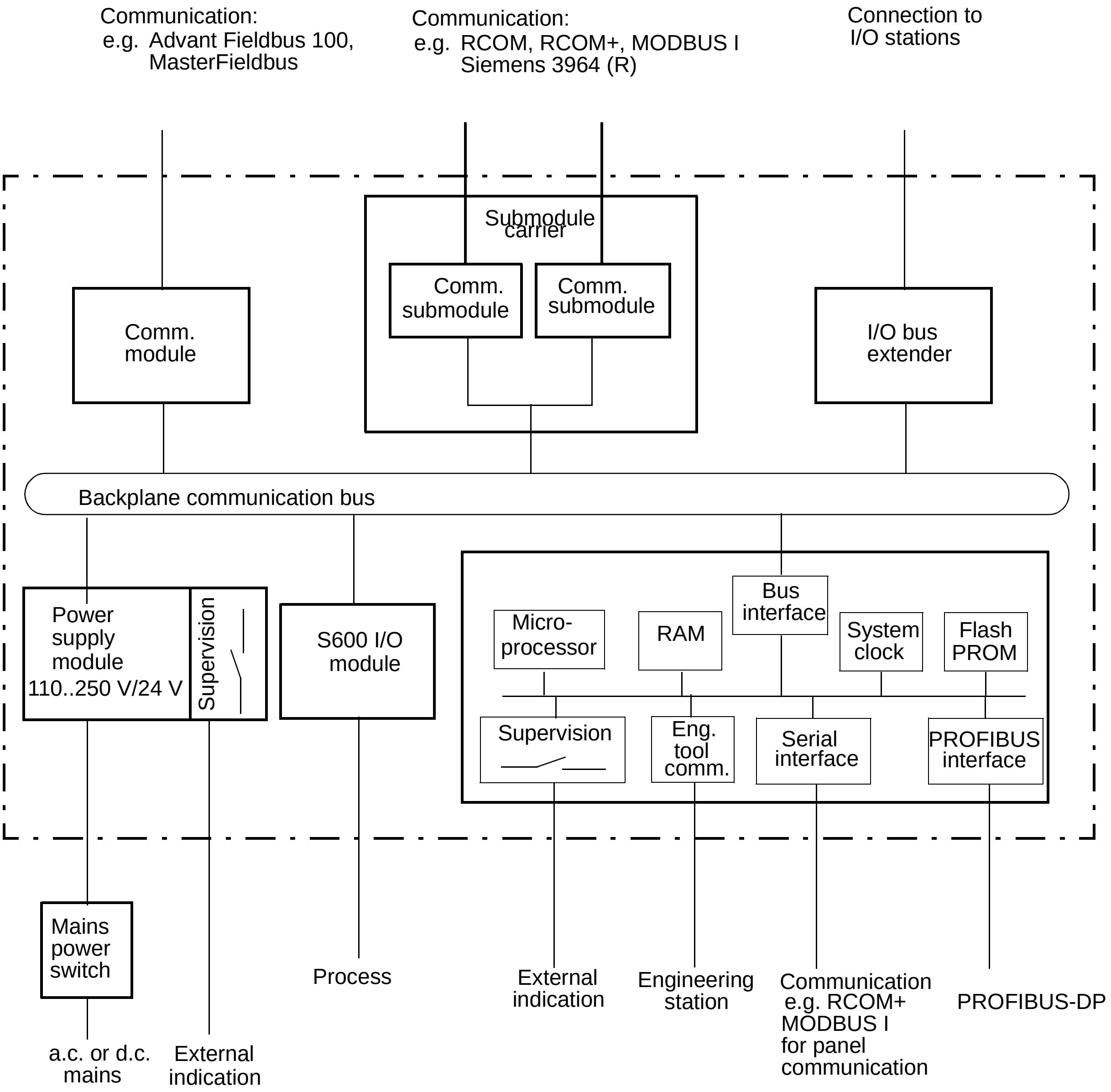


Figure 3-2. Block Diagram of Advant Controller 110 with Processor Module

3.1.1.3 Functional Interfaces

Besides the more “internal” communication, a controller also communicates with a wide range of peripherals. Figure 3-3 is scheduling the main functional interfaces.

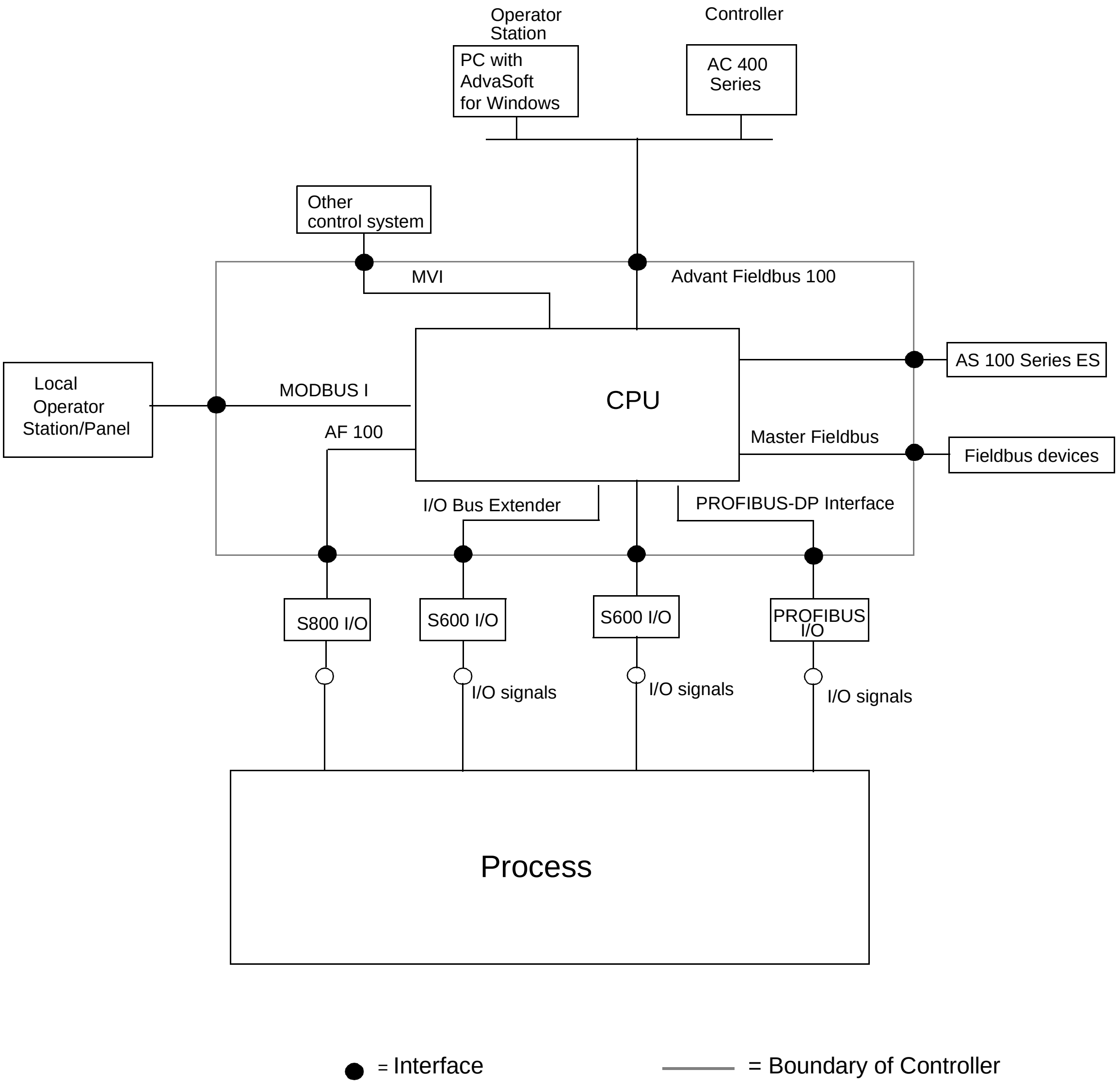


Figure 3-3. Advant Controller 110 Functional Interfaces

3.1.2 General System Utilities

Appropriate Hardware and Software

Most functions and equipment described as General System Utilities are included in the basic unit of a controller (smallest unit to be ordered) loaded with the basic system program. You can enlarge this platform further with alternatives and options.

3.1.2.1 System Clock

Appropriate Hardware and Software

No extra hardware or software is needed.
On PM633 and PM634 external synchronization is possible by a "minute pulse" at the SYNC input, see Figure 3-4.

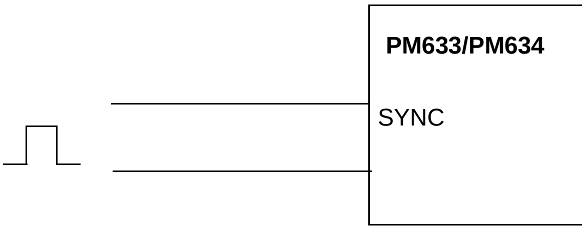


Figure 3-4. External Synchronization of System Clock

Contact data: see Section B.2, PM633 or Section B.3, PM634.

3.1.2.2 Run/Alarm Relay

Appropriate Hardware and Software

No extra hardware or software is needed.
In case of system shutdown the Run/Alarm relay contact of the processor modules PM632/PM633/PM634 is switched automatically according to Figure 3-5.

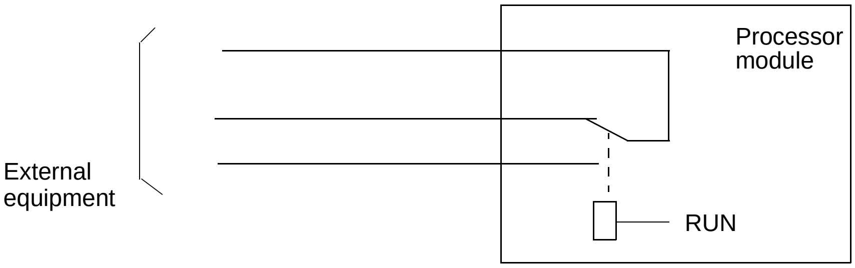


Figure 3-5. Run/Alarm Relay Connection

Contact data: see Section B.1, PM632 and Section B.2, PM633 and Section B.3, PM634.

3.1.2.3 Functional Content

Appropriate Software

No extra software is needed.
The Base Software which is part of the AC 110 Basic Unit has a functional content in accordance with:

- Logic control and time delays
- Sequence control
- Calendar time functions
- Arithmetic.

The above mentioned functions are realized in several PC elements.

For more detailed description of the Advant Controller 110 Base SW, see Section 1.8.2.2, Functions of BASE Software and Software Options.

3.1.3 Power Supply

System Power Supply

The subracks and modules can be supplied with an unstabilized 24 V DC voltage. All other voltages required on the modules are generated by converters on the modules themselves.

It is recommended that you use the mains supply module type SA610 to supply the system. The SA610 is housed in a standard module enclosure. Install it in the far right position(s) of the station. SA610 is capable of supplying a typical station comprising up to 20 modules.
Each subrack can accommodate a maximum of two SA610s so that, if the power requirement of a station exceeds the capacity of one SA610 module.

The Advant Controller 110 station can also be supplied from an external 24 V DC power source. You can use following power supply units:

SA160	input: AC 120 V, output: DC 24 V, 10 A
SA161	input: AC 230 V, output: DC 24 V, 10 A

Connect your external power source to the station's voltage terminals (USA/USB and ZD) on the subracks.

The ZD terminal is directly connected to the metallic frame and to the ground terminal on the subrack.

Use duplicated power supply units to provide redundancy.

You must interconnect the station voltage terminals of the basic and extension subrack of a station with the station voltage cables TK615 (see Figure 2-19).

NOTE

The station does not work reliably if you omit this connection.

Depending on differing needs for circuit breaker capacity, there are different types of power switch and distribution units specified to the individual installations. See the delivery documentation.

Detailed information on, for example, terminal block dispositions, locations, connections between units, and so on, is also given in a circuit diagram enclosed with the controller's delivery documentation.

Information about installation of your power supply you can find in Section 2.2.10, Power Supply Connection. In addition, you can find more detailed hardware descriptions in Appendix C, Cabinet Configuration of this manual and for SA610 in the *S600 I/O Hardware Reference Manual.*

Power Supply for Field Equipment

Auxiliary equipment in the controlled system is normally powered separately. This means separate power supply units and fusing.

Appropriate Hardware

Alternative power supply systems are available. When you order, you can select a suitable alternative. Do not be concerned with number of included parts, but rather the number of power supply units. This number is calculated with respect to the actual number of I/O modules and subracks.
Normally, you do not have to deal with current consumption calculations.
There are, however, occasions with special requirements, special designs, and so on, when detailed information regarding current consumption is valuable. Find a description under the heading Guidelines, below.

Guidelines

- For a summary of the main requirements of the plant supply from a planning viewpoint, see Section 2.1, Site Planning.
- Auxiliary equipment in the controlled system is normally powered separately from the control system power supply. An exception is analog outputs, for example, 0-10 V, 4-20 mA, which are powered by the system power supply. Note that galvanically isolated analog outputs are powered separately
- Heavy current on/off loads are **always** powered separately.
- You can use the system power supply for transducers provided:
  - The need for current is small.
  - There is idle capacity in the available power supply units (see **Current Consumption**).
  - The transducer is grounded directly in the control system chassis.

Number of Power Supply Units

The use of the power supply module SA610 (2,5A d.c.) is recommended for processor modules PM632/PM633/PM634 and for S600 I/O. SA610 is housed in the standard S600 module enclosure and occupies one position in the subrack.

SA610 is capable of powering a typical I/O station consisting of one or two subracks. When one SA610 is not sufficient, two can be used in parallel.

For special utilization of the power supply units, you are advised to calculate the current consumption.

As an alternative you can use power supply units SA161/SA162 (DC 24V, 10A) especially for building a centralized power supply for several subracks. In addition to SA161/SA162 you can use also SA171/SA172 (DC 48V, 5A) for field power supply.

Current Consumption

As a rule, a SA610 (2.5A d.c.) supply unit is used to supply equipment with one or two subracks.

See *S600 I/O Hardware Reference Manual* for information about the current consumption of the available modules in Advant Controller 110. These tables hold typical data relevant to the actual type of calculation. It also holds power dissipation data to be used in calculating the heat generated in a cabinet. You can use the tables as a form when you make your own calculation.

Detailed information about current consumption of S600 modules you can find in
S600 I/O Reference Manual.

The total static and dynamic loads may under no circumstances exceed 100% of the capacity of the supply unit. As all current consumption information is typical and not an “absolute maximum,” it is recommended that you not load the supply unit beyond 90% of its capacity, including all static and dynamic loads.

Fusing in Distribution Unit

The system is protected with adequate internal fusing. In addition to fusing distributed to different apparatus, there are common miniature circuit breakers in the power switch and distribution units in the cabinets (see the terminal diagram form for the actual power supply system).

The superior distribution unit fusing protects the equipment with respect to:

- Internal fusing in the Advant Controller (for example, SA610)
- Rated current of connected equipment
- In-rush current at power switch-on
- Need to protect the power supply cables to the equipment installed.

The in-rush current at power switch-on must be considered at the fuse dimensioning. Consequently, you must include redundant power supply units (connected to the same line) in the calculation of number of units. Normally, redundant power supply units are connected to separate lines.

3.1.4 Process Interface

3.1.4.1 I/O Systems for AC 110

An Advant Controller 110 communicates with the process through various types of sensors and actuators connected to the I/O modules. Advant Controller 110 is capable of employing two different I/O systems:

- S600 I/O
- S800 I/O.

Both systems provide high interference suppression. See *ABB Master Environmental Immunity.*

The S600 I/O is used as local I/O system close to the controller, in the controller subrack or cabinet.

The S800 I/O is intended to be used as remote I/O system connected to Advant Controller 110 via AF 100. Cabling represents a large portion of the cost of installing a process control system. In order to reduce this cost the remote S800 I/O system is available covering the most common process signal types.

Process events can be time-tagged. Time tagging can be executed by certain I/O modules itself or by application program. Thus the time accuracy is determined by the selected I/O module type or by the scan time parameter for event detection in the application program.

Both systems S600 I/O and S800 I/O can be connected to Advant Controller 110 simultaneously.

You can find more detailed information of the S600 I/O system (hardware descriptions and technical data of I/O modules) in *S600 I/O Hardware Reference Manual.*

The S800 will not be described in this document. Since the S800 I/O system is common to several Advant Controller products, find the complete description in separate documents:

- S800 I/O: System description, hardware description and technical data of I/O modules and AdvantFieldbus 100, see *S800 I/O Hardware User's Guide.*
- The remote S800 I/O communicate with the controller through Advant Fieldbus 100: see Advant Fieldbus system description, hardware description, and technical data in *AdvantFieldbus 100 User's Guide.*

For function descriptions, including configuration and application building information on I/O modules and signals, which are applicable to the actual Advant Controller 110, see *Data Base Elements Advant Controller 100 Series Reference Manual*.

General Signal Paths

The input and output signals can be in digital or in analog form (current or voltage signals). Figure 3-6 shows, in principle, the layout of the signal paths for the input and output signals for the different I/O systems. The signal paths are built up of the following units, which are described in principle below.

S600 I/O:

- External signal cable
- I/O module
- Backplane communication bus.

S800 I/O:

- External signal cable
- I/O module
- Internal module bus
- Communication module for Advant Fieldbus 100
- Advant Fieldbus 100.

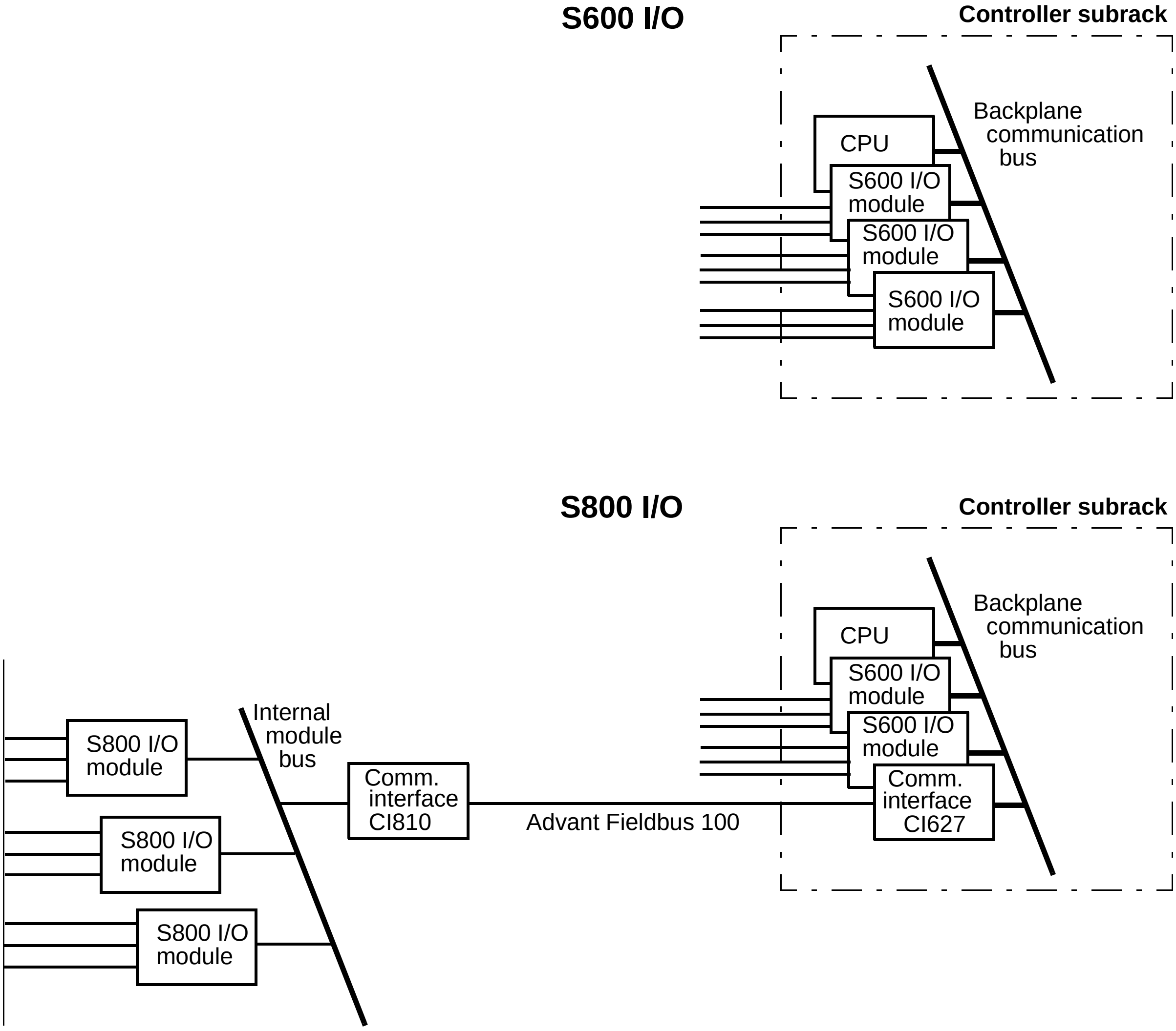


Figure 3-6. Input and Output Signal Paths (Principle)

External Signal Cable

The process cables are connected to screw terminals on the process connector of the I/O modules.

For S600 I/O-modules also process connectors with prefabricated cable are available.
The connectors can be supplied with different cable length.

I/O Module

I/O modules convert incoming electrical signals from the process controlled, so that they can be further processed in the processor module. Outgoing signals are adapted to their functions in the process. I/O modules are divided into the following groups:

- Digital input modules
- Digital output modules
- Analog input modules
- Analog output modules
- Pulse counter/frequency measurement modules
- Others.

You can exchange I/O modules while the system is running. You can also insert new modules live, provided they are predefined in the data base. A newly inserted module is taken into operation within 10 seconds.

Appropriate Hardware and Software

No extra software is needed. The set of base software and software options BASE, OPT2 (MVI support) and OPT3 (event handling), which is always included with the Advant Controller 110, is sufficient.
For S600 I/O no extra hardware is needed besides the desired I/O module if:

A spare slot in a subrack is available.

Supported I/O modules (S600 I/O) are listed in Appendix A, Hardware Components. You can also find information about suitable process connectors, and cables in Section 2.2.14, S600 I/O. Further guidelines are given below.

Interface to Application Program

Each I/O module is normally represented by a **data base element**. The same applies to the individual channels of the module, for example, for a digital input module in the S600 I/O, there is a superior DI module element and 32 Digital Input channel elements.

The module elements are created by the user. As a result, the data base elements for the individual channels (for example, inputs, outputs) appear automatically.

With the given DB element and module type as a reference, you can find functional and hardware descriptions in: *Data Base Elements Advant Controller 100 Series Reference Manual* and *S600 I/O Hardware Reference Manual*.

Guidelines

The following Section 3.1.4.2, S600 I/O System guides you in selecting suitable I/O for an application and some design rules.
By way of introduction, the question of I/O in the base station and I/O in an I/O station is discussed.

I/O in the Base Station

Free slots in the subracks of the base station may be used for the installation of I/O modules. Depending on the configuration there are up to 19 slots available for I/O modules in a base station.

I/O in an I/O Station

If the slots of the base station are occupied and there is still a need for more I/O modules, those I/O modules can be installed in up to 7 I/O stations (each with up to two subracks). An example is shown in Section 1.8.1.4, Example of Advant Controller 110 System Structure.

With respect to programming, I/O modules in an I/O station behave like those is in the base station. Timing and reaction time is the same, too.

Note that the length of the extension bus between base station and I/O stations must not exceed 20 m in total.

3.1.4.2 S600 I/O System

Guidelines - General

There are certain restrictions in number of I/O subracks, number of I/O modules and number of signals. See Section 3.2, Capacity and Performance.

There are no restrictions on mixing of I/O modules of different categories in a subrack. There are, however, some production rules to facilitate ordering and rapid delivery. See Section 2.1.4, Standard Layout and Disposition of Cabinets.

When you design a control system, it is desirable to leave some spare capacity. It is practical to have approximately 10% to 20% of the channels as spares. The same recommendation is valid for spare space in subracks.

You can add new I/O modules on-line. The corresponding data base module elements you can add also to your application program on-line.

Guidelines - Analog Inputs

General

With current signals and series coupling of loads, the total resistance may not exceed the resistance through which the sensor output can be driven.
The analog inputs are scanned by the CPU just before the execution of a program module (for example, control module). Thus the update rate depends on the cycle time of the corresponding control module programmed in the application program.

AI610

32 single-ended, non-isolated inputs for connection of non-grounded sensors.
Input range 0...20 mA.
With serial connection of loads in a current loop, there should be only one grounding point. This means that loads which are connected in series with AI610 must be differential or isolated from ground. See Figure 3-7.

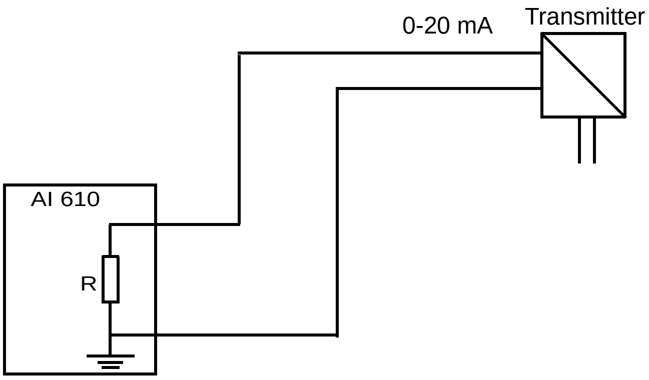


Figure 3-7. Connection in Series with AI610

When voltage signals are connected in parallel, grounding is to be at one point only, the ground point in the AI610.

AI625

16 single-ended inputs with common ground, isolated from the system as one group, common mode voltage 50 V. Transmitter supply is provided by the I/O module.
Input range 4..20 mA.
These are used for the connection of non-grounded sensors which shall be isolated from the system.

AI620

16 differential inputs for individually grounded sensors, common mode voltage 100 V.
Input range 0...20 mA, 4...20 mA, -20...+20 mA, -10...+10 V.
These are used when it is necessary to ground measurement circuits at different places in the system. This means you can use transducers which require grounding of the signal zero.

AI630

12 inputs for resistors or Pt 100 transducers, connected with three-wire or four-wire.
Input range 0..500 Ohms or -200..+600 °C.
The inputs are isolated from the system as one group.

AI635

14 differential inputs for millivolts or thermoelements and 2 inputs for ambient (CJ) temperature measurement with Pt 100, common mode voltage 100 V.
Input range -5..+25 mV, -10..+50 mV, -15..+75 mV, -25..+150 mV, thermoelements type B, C, E, J, K, N, R, S, and T.
Both grounded and non-grounded thermoelements can be used.

Guidelines - Analog Outputs

AO610

16 outputs, isolated from the system as one group, short-circuit and open-circuit proof.
Output range 0..20 mA or 0..10 V.
The load resistance of a current output is 600 Ohms maximum.

AO650

8 outputs, each output separately isolated, short-circuit and open-circuit proof.
Output range 0..20 mA, 4..20 mA, -20..+20 mA, 0...5 V, 1..5 V, 0..10 V, -10..+10 V.
The load resistance of a current output is 600 Ohms maximum.

Guidelines - Digital Inputs

All the S600 digital input modules have one or several inputs for monitoring the external supply voltage UP. The digital inputs are scanned by the CPU just before the execution of a program module (for example, control module). Thus the update rate depends on the cycle time of the corresponding control module programmed in the application program.

Some of the S600 digital input modules can be configured for pulse catching or event recording, too. Pulse catching means selectable filtering as well as prolongation of positive input pulses. Event recording means the recording of changes of the input signal together with a time stamp. The time stamps of the S600 I/O modules have a resolution of 1 millisecond.

DI610

32 non-isolated inputs. Input voltage 24 V d.c.

DI620

32 inputs, isolated in four groups. Input voltage 24 V d.c.

DI621

32 inputs, isolated in four groups. Input voltage 48 V d.c.

DI622

32 inputs, isolated in four groups. Input voltage 60 V d.c.

DI635

16 inputs, isolated in four groups. Input voltage 120 V a.c.

DI636

16 inputs, isolated in four groups. Input voltage 230 V a.c.

DI650

32 inputs, isolated in four groups. Input voltage 24 V d.c.
Can be configured for pulse catching or event recording.

DI651

32 inputs, isolated in four groups. Input voltage 48 V d.c.
Can be configured for pulse catching and event recording.

DI652

32 inputs, isolated in four groups. Input voltage 60 V d.c.
Can be configured for pulse catching and event recording.

Guidelines - Digital Outputs

The S600 digital output modules have solid state (semiconductor) or relay outputs. The different output types have partially different properties. Certain significant properties are presented below:

- Solid state outputs
  These generally have a long service life, even with a high switching frequency.
- Relay outputs
  These have a shorter service life than solid state outputs. When the output is frequently changed, it is subject to wear and its service life is shortened. They can withstand occasional higher voltage. Different system voltages can be accommodated on the same board. A certain degree of inductive load can be accepted. Small load currents with low voltage (<40 V) can give contact problems.

DO610

32 solid state outputs, non-isolated, with short-circuit protection. Output 24 V d.c., max. 200 mA. The module has an input for monitoring the external supply voltage UP.

DO620

32 solid state outputs, isolated in four groups, with short-circuit protection. Output 48 V d.c., max. 500 mA.

DO625

16 solid state outputs, isolated in eight groups, with short-circuit protection. Output 24 V d.c., max. 2 A.

DO630

16 relay outputs, each output separately isolated. Output 24...250 V a.c./d.c., max. 2 A. Breaking capacity is 500 VA for a.c. loads and 40 W for d.c. loads.

Guidelines - Pulse Counting

DP620

5 counters for up to 100 kHz, each with inputs A, B, Strobe and Set (24 V only). Each input is separately isolated.
Inputs 5 V, 24 V or ±13 mA d.c.
Each counter can be configured for up counting, up/down counting, frequency measurement, difference measurement, position measurement and rotation speed measurement.

3.1.5 Communication

3.1.5.1 Provided Link Types

Communication Survey

The table below shows the communication links available for Advant Controller 110 and the systems you can connect with. You can find more detailed information for each link in the following subsections.

Table 3-1. Communication Survey

Equipment	Used Link(s)	Functionality (Explanations Below)
Advant Controller 410/450	Advant Fieldbus 100, RCOM, RCOM+	R I B E
	MasterFieldbus	R I B
Advant Controller 110	Advant Fieldbus 100, RCOM, RCOM+	R I B E
Advant Controller 55	RCOM, RCOM+	R I B E
MasterPiece 200/1	MasterFieldbus, RCOM	R I B
S600 I/O	Bus Extension to S600 I/O	R I B E 1)
S800 I/O	Advant Fieldbus 100	R I B
TYRAK L, SAMI	MasterFieldbus	R I B 2)
Advant Station 100 Series Engineering Station	Serial interface of CPU, Advant Fieldbus 100	3)
AdvaSoft for Windows	Advant Fieldbus 100	R I B E
Local Operator Station / MMI	Modbus I	R I B
Other manufacturers’ equipment	Siemens 3964, Modbus I PROFIBUS-DP	R I B R I B 1)

Explanations

1. Read/write process I/O data.
2. The control of d.c. motors in a drive system is integrated in the converter, which involves a considerable exchange of signals with Advant Controller 110. A special communication package implemented in the converter makes this adaptation possible.
3. Configuration data transfer, application program loading and commissioning functions. **R, I, B** indicates Real, Integer and Boolean data, respectively. Bidirectional information flow is possible. **E** indicates handling of time-stamped events.

Data Set Peripherals

Information is exchanged between separate controllers (and between a controller and other equipment indicated in Table 1-22) by means of "Data Set Peripherals" (DSP), that is, messages containing aggregates of data base information. Data Set Peripherals are explicitly specified in the communicating controllers, as part of the application programming.
With a Data Set Peripheral, the communication normally transmits data cyclically between the nodes. The cycle time is selectable from 1 ms upwards.
In addition to Data Set Peripherals, other variants exist, for example, MVI Data Block (MVB).

For a detailed description of Data Set Peripheral, see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

Appropriate Hardware and Software

From a hardware viewpoint, communication interface modules or the concept of communication interface submodule and submodule carrier is used to build a function. Refer to Section 2.2.14.2, Assembly for a description.
For information on the possible number of instances, see Section 3.2.5.1, Provided Link Types.
Information given is valid to the controller end of the communication.

Table 3-2. Link Types, Hardware and Software

Link Type	Communication Interface Module	Software Option	Comments
Advant Fieldbus 100	for coax bus cable: CI626V01 for twisted pair bus cable: CI627	-	
MasterFieldbus	as Master: CI671 as slave: CI670	-	
Bus extension to S600 I/O	for base station: CI615 for I/O station: CI610	-	
PROFIBUS-DP	using interface at processor module PM634		Only available with PM634
RCOM	using second serial interface at processor modules PM632, PM633, or PM634	OPT5 (RCOM driver)	
RCOM	submodule CI532V01 and submodule carrier SC610	OPT2 (MVI support)	
MODBUS I (slave function only)	using second serial interface at processor modules PM632, PM633 or PM634	OPT4 (Modbus I driver)	(1)
MODBUS	submodule CI532V02 and submodule carrier SC610	OPT2 (MVI support)	
SIEMENS 3964R	submodule CI532V03 and submodule carrier SC610	OPT2 (MVI support)	

(1) MODBUS (slave function) means that Advant Controller 110 is the slave with a fixed slave number 1. Because of RS-232-C MODBUS can only be used as point to point network.

Guidelines - Location and Exploitation of Hardware

- No restrictions in location of CI670, CI671, CI615 and submodule and submodule carrier in controller subrack.
- Use leftover slot on a submodule carrier provided the actual submodule is suitable to the carrier. CI626 or CI627 have to be located at position 2 to 20 in the subrack of the base station.
- CI610 has to be located at position 1 in the subrack of the I/O station.

Guidelines - Multi Vendor Interface (Standard Protocol)

- Communication interface CI532Vxx has two ports. Both ports have the same protocol.
- Submodules of type CI532Vxx fits into submodule carrier SC610.
- CI532Vxx is delivered with a standard protocol, for example, RCOM, Modbus, Siemens, and so on. Different protocols are sold as different articles: CI532V01, CI532V02, and so on, "V" stands for variant.

3.1.5.2 Applied Communication

Interface to Application Program

Table 3-3. Applied Communication, Used Links and Interface to Application Program

Equipment	Used Link(s)	Software Interface[(1)]	
		Link DB Elements	**Application DB/PC Elements**
Advant Controller 410/450	Advant Fieldbus 100	CI626/CI627	Data Set Peripheral, DAT
	RCOM, RCOM+	CI532 or RCOM/RCOM+ at second serial interface of PM632/PM633/PM634, MVICHAN, MVINODE	MVB, DAT
Advant Controller 110	Advant Fieldbus 100	CI626/CI627	Data Set Peripheral, DAT
	RCOM, RCOM+	CI532 or RCOM/RCOM+ at second serial interface of PM632/PM633/PM634, MVICHAN, MVINODE	MVB, DAT
Advant Controller 55	RCOM, RCOM+	CI532 or RCOM/RCOM+ at second serial interface of PM632/PM633/PM634, MVICHAN, MVINODE	MVB, DAT

Table 3-3. Applied Communication, Used Links and Interface to Application Program (Continued)

Equipment	Used Link(s)	Software Interface[1]	
		Link DB Elements	**Application DB/PC Elements**
MasterPiece 200/1	MasterFieldbus	CI670	PC: MBF-IN, MBF-OUT
	RCOM	CI532 or RCOM at second serial interface of PM632/PM633/PM634, MVICHAN, MVINODE	MVB, DAT
S600 I/O	Bus Extension to S600 I/O	for base station: CI615 for I/O station: CI610	I/O element
S800 I/O	Advant Fieldbus 100	CI627	I/O element
TYRAK L, SAMI, and so on	MasterFieldbus	CI671	PC: COM-CVI1, COM-CVO1
Advant Station 100 Series Engineering Station	first serial interface of PM632, PM633, or PM634	Not needed	Set of commands Configuration data
AdvaSoft for Windows	Advant Fieldbus 100	CI626/CI627	Data Set Peripheral, DAT
Local Operator Station / MMI	Modbus (slave function) at second serial interface of PM632, PM633, or PM634	Not needed	DAT
Other manufacturers' equipment	MultiVendor Interface (for SC610) - Modbus - Siemens 3964R	CI532	MVB, DAT
	- PROFIBUS-DP	PB	I/O element

(1) Generally data base elements are given for establishing the link and the interface to the application program. PC: denotes PC element.

Guidelines - Data Set Peripheral Communication

Designation of Data Set Peripheral

Data Set Peripherals (DSP) are used with signal exchange between, for example, controllers. A Data Set Peripheral is defined by a data base element which states if it is a transmitting or receiving Data Set Peripheral, the cycle time and from where the information is received or to where it is transmitted. The data base element for a Data Set Peripheral also refers to a number of DAT elements. These DAT elements contain, in turn, the values which are to be transmitted/received.

When a DSP and associated DAT elements are allocated names, it is important to be able to trace the origin of the data, that is, where the data originates. One way is to give a Data Set Peripheral a name in accordance with DSP "from node number" - "to node number".
If a Data Set Peripheral is transmitted from node 12 to node 11, it is given the name DSP12-11.

Associated DAT elements can be given the name DSP12-11.R1 (which is obtained automatically if a real DAT element is created with the help of DSP).

As an alternative, you can give DAT elements function-describing names (of up to 12 characters).

Performance Considerations

Information given in Section 3.2, Capacity and Performance shows that increasing the number of Data Set Peripherals causes more load than increasing the number of DATs. Thus you should minimize especially the number of Data Set Peripherals.

3.1.5.3 Bus Extension

Outline Description

If an Advant Controller 110 system needs more than two subracks, it can be extended by adding Advant Controller 110 I/O stations. Adding I/O stations to a base station necessitates bus extenders and bus extension cables. I/O extension modules are also used, where the physical distribution of a system requires that I/O modules be accommodated in different cabinets.

An extension bus can be up to 20 meters long and must always be a single continuous line, that is, branches and radial configurations are not permitted. A bus terminator must be mounted in the last I/O station at the end of the bus extension cable. The termination at the near end is included in the bus extender CI615. Two extension cables are never connected to a bus extender CI615 nor are two bus terminators ever used in an I/O system.

NOTE

CI615 may not be inserted or removed while the application program is running.

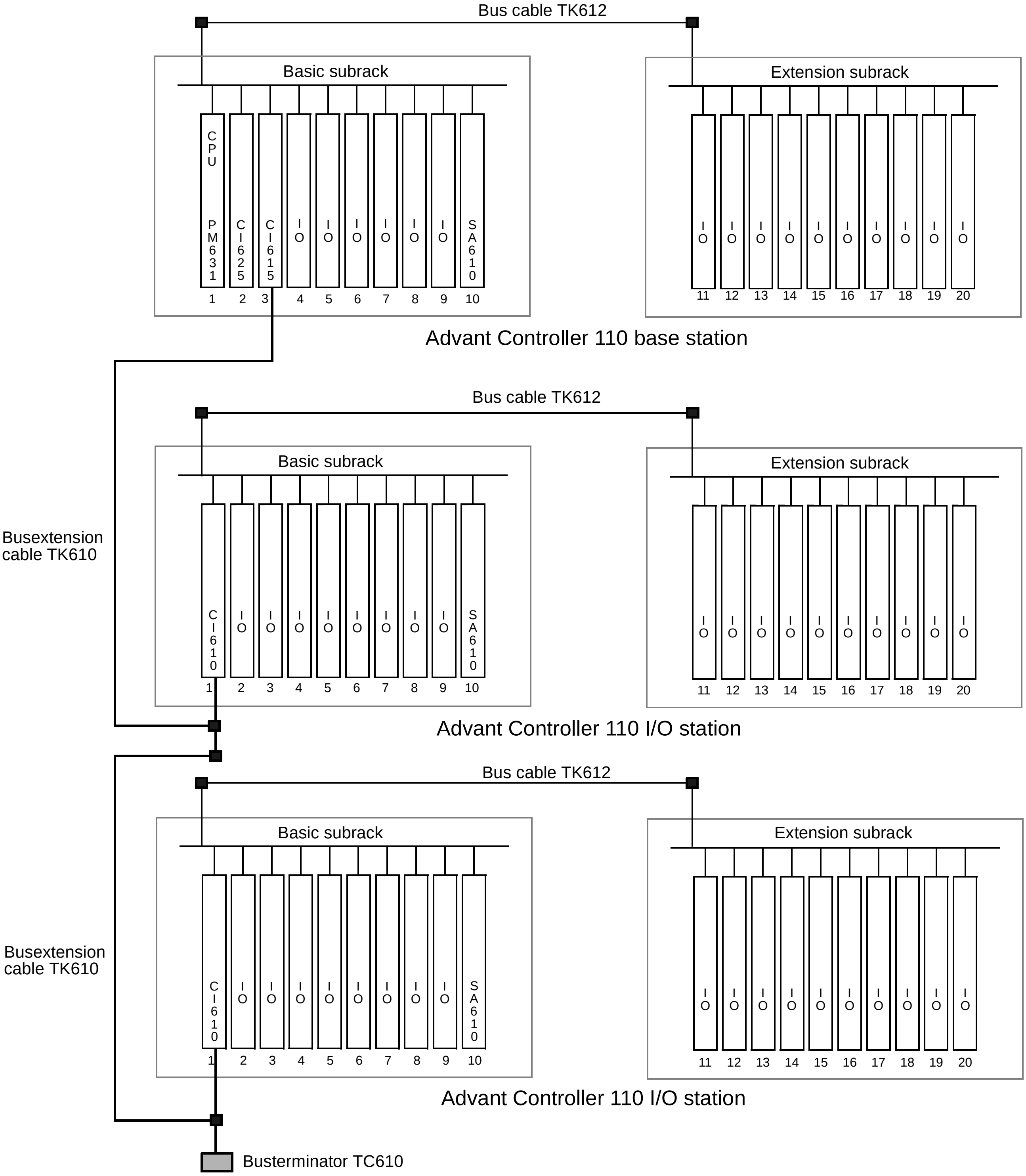


Figure 3-8. Example of System Configuration with Two AC 110 I/O Stations

Bus Extender CI615 for Base Station

The bus extender CI615 enables you to add up to seven I/O stations, via the I/O extension bus, to a base station. Only one CI615 module can be mounted in a base station.

The main functions are:

- Data transmission from CPU to I/O module and vice versa
- Termination of extension bus
- Detection of open-circuit cables.

Bus Extender CI610 for Advant Controller 110 I/O Station

The bus extender CI610 connects a Advant Controller 110 I/O station to the I/O extension bus. A CI610 can be addressed and configured by the CPU in the same way as any I/O module.

The main functions are:

- Data transmission from I/O extension bus to the I/O station
- Station address decoding
- Supervision of data transfer
- System power supply supervision.

This section gives you an overview of bus extension. You can find more detailed technical information about CI615 and CI610 (hardware descriptions and technical data of I/O modules) in *S600 I/O Hardware Reference Manual.*

3.1.5.4 MasterFieldbus

Outline Description

MasterFieldbus is a high-speed communication link that is intended to connect Advant Controller 110 to converters for motor drives (TYRAK L or SAMI). It is also possible to connect Advant Controller 410/450 or MP200.

You can connect up to 4 buses (master and/or slave interfaces) to one Advant Controller 110 and each bus can take up to 16 remote units.

There are 2 types of coupler modules: CI670 and CI671.

CI670 provides a MasterFieldbus slave interface operating at 375 kbit/s. This speed is used, for example, when communicating with Advant Controller 410/450 or MP200.

CI671 provides a MasterFieldbus master interface. You can select a transmission speed of 375 kbit/s or 2 Mbit/s. CI671 is used to connect converters for motor drives (TYRAK L or SAMI).

You can disconnect remote units from the bus and replace them without disturbing other units or their communication with Advant Controller 110. Communication with a reconnected unit is resumed automatically.

For distances up to 25 m (82 ft.), use MasterFieldbus with twisted pair cable and without modems. For longer distances, use modems. Both coaxial and optical types of cable are available.

For increased availability, you can duplicate the cables and modems (physical redundancy).

This section gives you an overview of Master Fieldbus slave and master interface. You can find more detailed technical information about CI670 and CI671 (hardware descriptions and technical data of I/O modules) in *S600 I/O Hardware, Reference Manual.*

For a detailed description of the MasterFieldbus, including installation guidelines, see *MasterFieldbus User's Guide*.

MasterFieldbus Slave Interface CI670

Use the communication interface CI670 to connect Advant Controller 110 as a slave station to the MasterFieldbus.

The main function of the communication interface CI670 concerns the process data exchange between the Advant Controller 110 and the MasterFieldbus Short-Distance Bus. Another important task performed by the CI670 is supervision of data traffic to its connected partners.

Place the communication interface CI670 in the base station near the CPU. There are no restrictions to a particular position in the Advant Controller 110 subrack. After CI670 is inserted in its passive state, no data are driven to the MasterFieldbus. After the Advant Controller 110 CPU activates CI670 (communication interface is set to operation and the green LED RUN is lit) and downloads the programmed configuration, the data exchange on the MasterFieldbus takes place.

You can use the ABB MasterFieldbus as a communication link to connect the Advant Controller 110 to Advant Controller 410/450 as shown in Figure 3-9.

Data exchange between the Advant Controller 110 and Advant Controller 410/450 is maintained by the PC elements MFB-IN and MFB-OUT. Refer to *PC Elements Advant Controller 100 Series Reference Manual* for further description.

Disable unused CI670 channels at the ACT terminals of their DB elements.

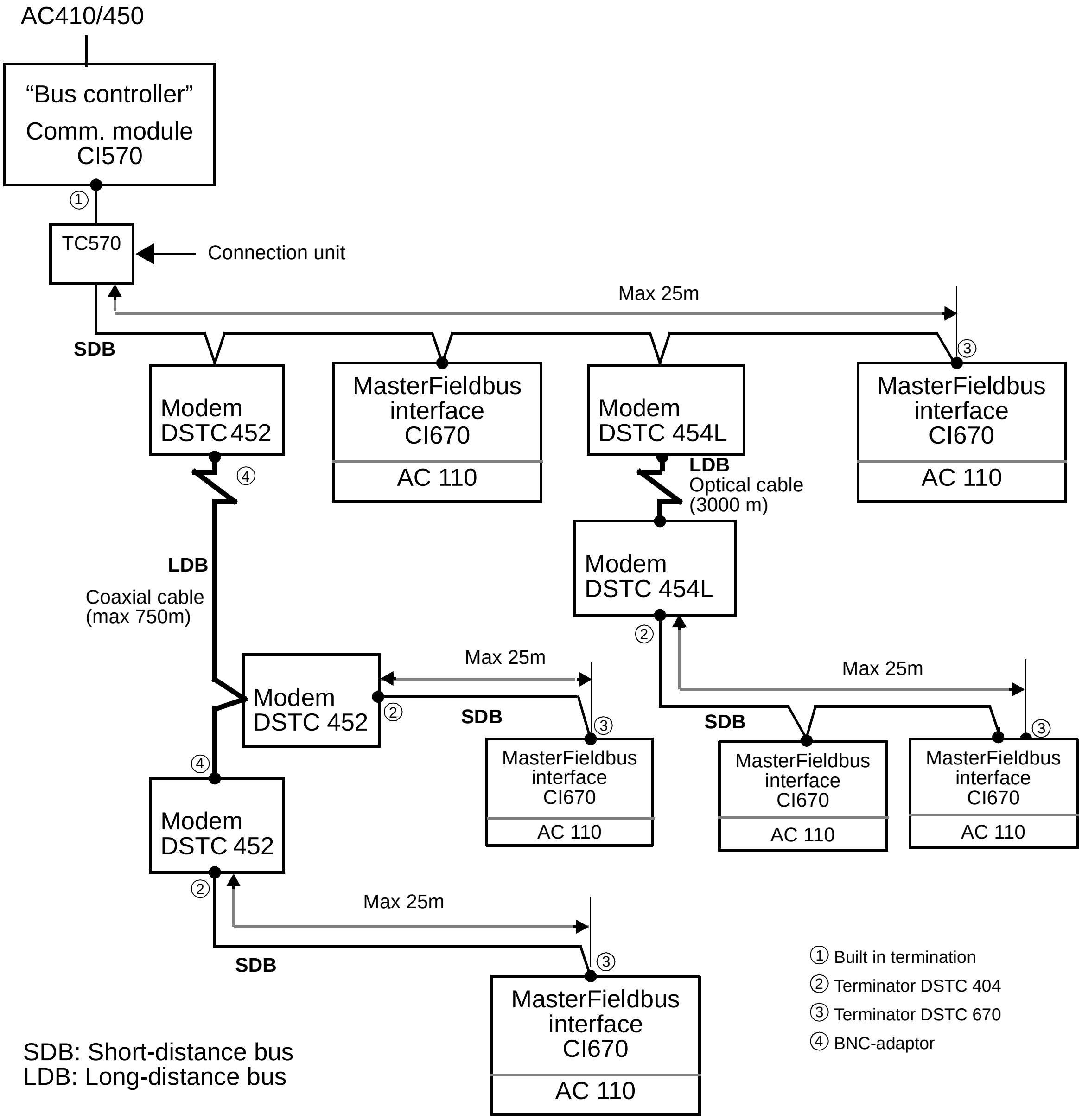


Figure 3-9. Advant Controller 110 Connection to MasterFieldbus via CI670

MasterFieldbus in Figure 3-9 is a master/slave communication system with Advant Controller 410 or 450 as master and Advant Controller 110 as slave.

The Short-Distance Bus (SDB) is intended for serial communication up to 30 m because the maximum ground potential difference on the SDB must be within ±7 V in order to guarantee proper operation. The length of the Long-Distance Bus (LDB) can be increased to 3000 m (750 m) using optical fiber (or coaxial) cables.

The communication interface CI670, as well as the Advant Controller 410/450 CI570 fieldbus controller, is always connected to the SDB. To achieve LDBs, connect modems DSTC 454 (for optical fiber cable) or DSTC 452 (for coaxial cable) to SDBs.

You can connect four fieldbusses with up to 16 Advant Controller 110 stations each to a Advant Controller 410/450 station.

Transmission speed is 375 kBaud (fixed). With a maximum bus configuration (for example, 16 active nodes on one fieldbus), data is transmitted from each Advant Controller 110 to Advant Controller 410/450 at 50 ms intervals.

Physically, MasterFieldbus consists of a CI570 fieldbus controller mounted in the CPU rack of the Advant Controller 410/450, a DSTC 408 connection unit, an SDB formed by a screened twisted pair cable, and one or more CI670 communication interfaces in the base station of an Advant Controller 110. For LDBs, additional modems and appropriate coaxial or optical fiber cables are used.

You can connect up to 10 modems to an LDB. Two LDBs cannot be connected in series with intermediate SDBs.

A CI670, located at the far end of the SDB, must terminate the bus by front connector type TC670.

You can disconnect an Advant Controller 110 station from the MasterFieldbus without affecting the other modules. A reconnected module is automatically included in the configuration.

MasterFieldbus Master Interface CI671

The CI671 communication interface is an interface between an AC 110 process station and a MasterFieldbus which may connect different peripheral devices of node type TYRAK-L communication protocol such as converters, remote I/O and older PLC types.

The communication interface CI671 performs three tasks:

- Master on MasterFieldbus
- Process data exchange between the Advant Controller 110 and remote units
- Supervision of data traffic to its connected units.

After insertion, CI671 is in the passive state, that is, no data is driven to the MasterFieldbus. With the downloading of configuration data from the Advant Controller 110 CPU, the CI671 is set to the active state (indicated by green LED RUN) and connection is established to reachable nodes via MasterFieldbus.

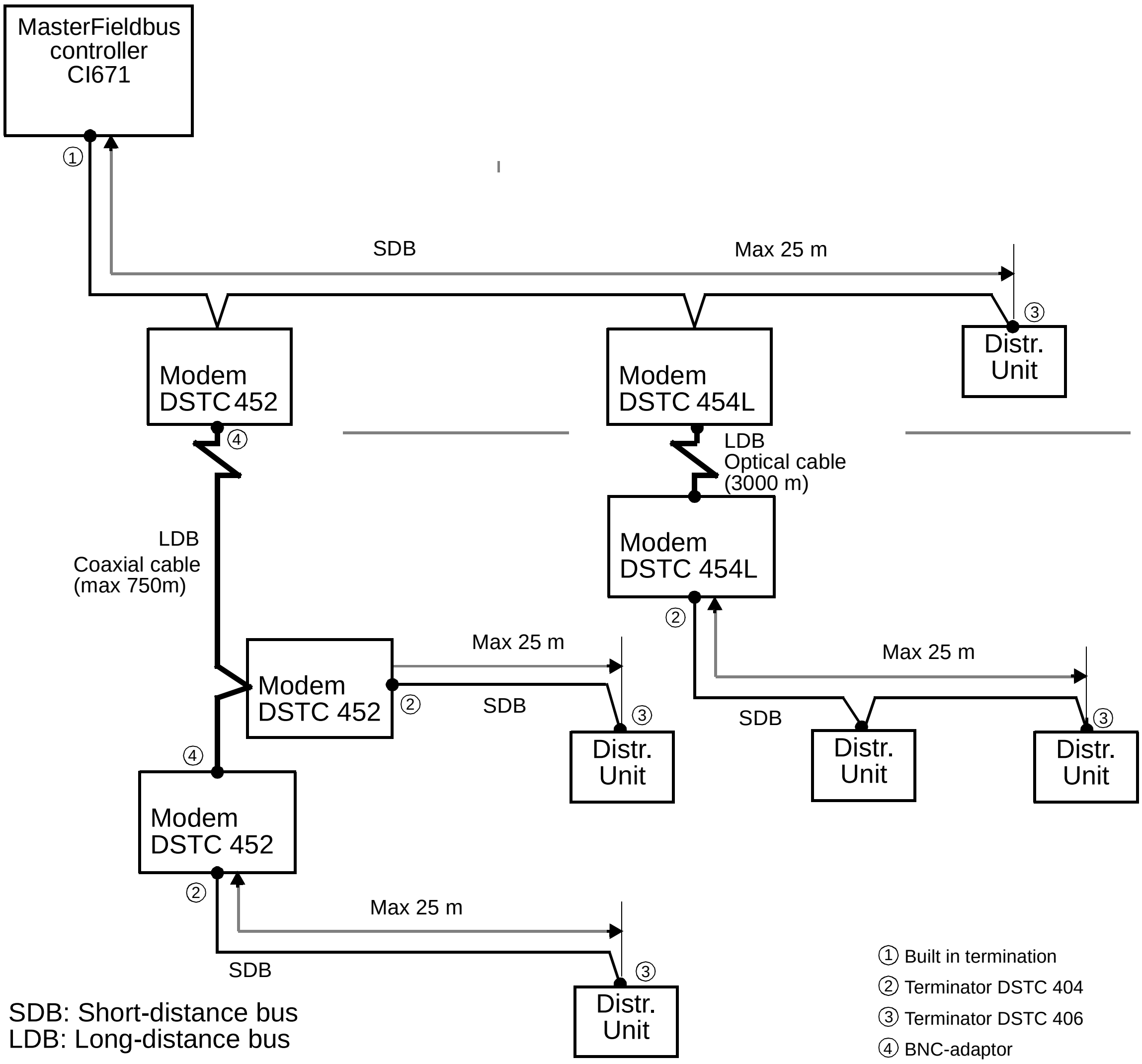


Figure 3-10. Advant Controller 110 Connections for MFB via CI671

The communication interface CI671 is always connected to a primary SDB (Short-Distance Bus). Long-Distance Buses (LDBs) connected via modems.

The following limitations are given when you use a CI671 in an Advant Controller 110:

- You can install a maximum of four controllers in one Advant Controller 110.
- You can connect a maximum of 16 remote units to one controller.
- You can connect a maximum of 10 modems units to an LDB.
- You cannot connect two LDBs in series with intermediate SDBs.

The active termination of MasterFieldbus is built-in in the CI671 communication interface.

The CI671 polls the remote units at regular intervals.

Data exchange between the Advant Controller 110 and remote units is maintained by the PC elements COM-CVI1 and COM-CVO1 on the Advant Controller 110 side. Refer to the manual *PC Elements Advant Controller 100 Series Reference Manual* for further description.

As long as no corresponding COM-CVO1 is active, only empty data frames are transmitted to the concerned slave.

3.1.5.5 Advant Fieldbus 100

Outline Description

Advant Fieldbus 100 (AF100) is a high-performance bus specially designed for real-time applications. A number of different products are connectable to Advant Fieldbus 100, that is, Advant Controller 410/450, Advant Controller 110, ACV 700 Converter, and so on. It features reliable, cyclic data transfer (using Data Sets) as well as event-driven background transfer of service data.
Advant Fieldbus 100 also features a distributed master scheme. If one or several controllers are lost, the bus is not affected and operations continue.

For increased availability, you can duplicate the cables and modems (physical redundancy).

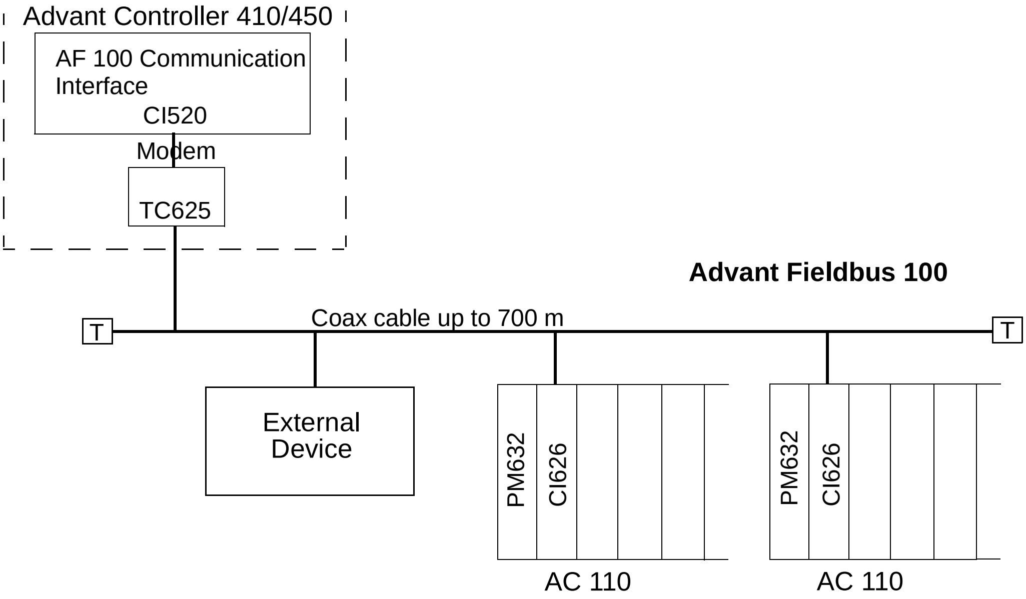


Figure 3-11. Example of an Advant Fieldbus 100 Configuration

The transmission speed of the bus is 1.5 Mbit/s, and the code is Manchester Biphase L with a code violation preamble and CRC check according to IEC TC57. The transmission quality and frame length are supervised. The above features guarantee a Hamming distance of eight.

There are two types of AF100 communication interface modules:

- CI626V01 for coaxial bus cable
- CI627 for twisted pair bus cable.

For CI626 the physical layer is a bus comprising a coaxial cable with a BNC T-adaptor connected to the CI626 communication interface over a short drop cable. A cable with 80 nodes can be driven by the CI626. With an inexpensive 75 Ohms CATV cable with 7 mm diameter, a 300 m cable length is possible. With 11 mm diameter cable, you can have a cable length of 700 m. A foil screen is essential to minimize radiation (see *Product Guide* for cable specification). The coaxial cable must be terminated by 75 Ohms terminators at both ends.

Together with the opto-modem TC630 and opto-fibre cable, you can extend the bus length up to 1700 m. (See the *Advant Fieldbus 100 User's Guide*.)

The BNC T-adaptor can be connected to, or disconnected from, the CI626 communication interface without disturbing the communication between the other nodes on the bus. Using redundant buses, data is transferred via both by automatically switching between the lines.
In case of a disrupted line, the CI626 communication interfaces are switching to the intact line.

Please note that only the CI626V01 handles the redundant buses correctly. There has been a CI626V00 which cannot handle redundant configurations.

The only difference between CI627 and CI626 is the physical layer. CI627 uses twisted pair instead of coax cable. You can have a cable length of up to 700m for twisted pair too.

AF100 repeater modem TC513 is used as an interface between AF100 coaxial cable medium and AF100 twisted pair medium.

Data exchange on AF 100 is maintained by the DB element DSP. Refer to *Data Base Elements Advant Controller 100 Series Reference Manual* for further description of this element

The total number of DSP (sent and received) is limited to 200 for each communication interface CI626/CI627.

CI626/CI627

The main function of the communication interfaces CI626 and CI627 is service and process data exchange between the Advant Controller 110 and the Advant Fieldbus 100. Besides the function of bus administration, this interface can be time synchronization master or slave.

The communication interface CI626 or CI627 must be placed in the base station. Each base station can contain up to two AF 100 communication interface.

The AF 100 is a bus with a bus administrator node. Data transfer on the bus is controlled by the bus master through polling of the bus nodes.

The bus master function can be enabled or disabled by setting the attribute MASTER at DB element CI626 or CI627.

You can find more detailed technical information about CI626 and CI627 in *S600 I/O Hardware Reference Manual.*

Time Synchronization

The time synchronization facility enables the cyclic synchronization of the internal clocks of AC 110 stations within one AF 100 system.
A resolution of 100 microseconds and an accuracy of 15 milliseconds is achieved.

Communication with DSP

Communication between the AC 110/AC 400 stations via AF 100 is accomplished by Data Set Peripheral (data base) elements.
On both partners, one DSP exists with references to DAT elements. Both DSP have the same configuration values, except the SOURCE attribute.

3.1.5.6 RCOM

Outline Description

RCOM (Remote COMmunication) enables Advant Controller 110 to communicate/transmit data to other units over long distances via a serial V24/RS-232-C asynchronous communication bus.

RCOM+ is an RCOM protocol type with saver CRC check and no "Break" character in the transmission telegrams. RCOM+ is able to transfer MVI Data Blocks (MVB) with up to 24 DATs instead of up to 8 DATs in case of RCOM.

You can connect the following Advant OCS product lines and alien equipment to the Advant Controller 110:

- Advant Controller 50 series (RCOM, RCOM+)
- Advant Controller 100 series (RCOM, RCOM+)
- Advant Controller 400 series (RCOM, RCOM+)
- MasterPiece 200/1 (RCOM)
- Older types of ABB Master process stations or alien computers (RCOM).

RCOM/RCOM+ works with the master-slave principle. The communication is performed via point-to-point or multi-drop connection. You can also connect a dialing modem on telecommunication authority lines. The modem must have command-initialized dialing and an automatic reply function.

You can find detailed technical information (function description, installation, configuration, maintenance and technical data) about RCOM for AC 110 in *RCOM Advant Controller 110 User's Guide.*

You can install RCOM or RCOM+ in AC 110 in two ways:

- Using RCOM SW Driver on the second serial interface of AC 110 CPU module and AC 110 OPT5 SW
  Only one RCOM channel is supported in this case.
- Using the MultiVendor Interface (MVI) CI532V01 and AC110 OPT2 SW.

Guidelines - RCOM

- RCOM using second serial interface at PM632, PM633, or PM634

  This is only possible if just one RCOM channel is required and if local MMI option AC110 OPT4 SW (MODBUS driver) is not used on the second serial interface of the processor module. Depending on the communication speed up to one third of the processor's capacity is required to control RCOM. This solution is inexpensive since no MultiVendor Interface (MVI) CI532 is needed for RCOM.

- RCOM using submodule CI532V01 + submodule carrier SC610

  This solution must be chosen if the second serial interface of processor module is used for local MMI option AC 110 OPT4 SW or if several RCOM channels are required.

3.1.5.7 Siemens 3964(R)

Outline Description

MultiVendor Interface (MVI) is used to communicate with other manufacturers' control systems. The Siemens 3964(R) protocol is available as standard.

MVI (CI532) uses a V24/RS-232-C asynchronous serial communication link. This link allows communication at long distances via modem.

Siemens 3964(R) in AC 110 is called MVI-Siemens 3964(R) and is used for communication with, for example, other manufacturers' control systems (PLCs).

You can only use MVI-Siemens 3964(R) in point-to-point type connections. MVI-Siemens 3964(R) is available for the Siemens 3964 (no checksum) and the Siemens 3964R (with checksum) protocols. The link can operate in quasi-full-duplex mode, that is, both AC 110 and the PLC can take initiative to start a data transfer. The transmission speed is up to 19200 bits/s.

You can find detailed technical information about Siemens 3964(R) (function description, installation, configuration, maintenance and technical data) in AC 110 in
MVI - Siemens Advant Controller 100 Series User's Guide.

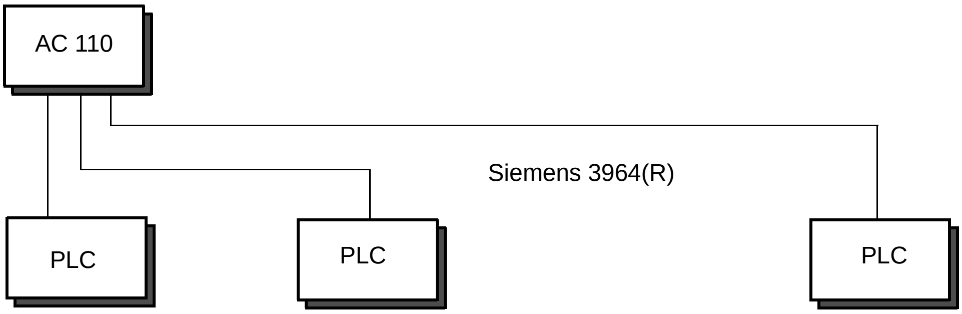


Figure 3-12. Example of an MVI-Siemens 3964(R) Configuration

3.1.5.8 Modbus

Outline Description

The Gould Electronics protocol MODBUS I is available as standard. You can use it for communication with, for example, other manufacturers' control systems (PLCs).
You can install MODBUS I in AC 110 in two ways:

- Using MODBUS I SW Driver on the second serial interface of AC 110 CPU module and AC 110 OPT4 SW
  Only slave function is supported in this case. That means Advant Controller 110 is MODBUS I slave with a fixed slave number 1.
  See Section 3.1.7.1, Local Operator for calculation of MODBUS I data address.
- Using the MultiVendor Interface (MVI) CI532V02 and AC110 OPT2 SW.

MultiVendor Interface (MVI) is used to communicate with other manufacturers' control systems. MODBUS I in AC 110 using MVI is called MVI-MODBUS.

MVI (CI532) uses a V24/RS-232-C asynchronous serial communication link. This link allows communication at long distances.

You can use MVI-MODBUS in point-to-point or multidrop type connections. The AC 110 acts as a master or slave station. MVI-MODBUS is available in RTU (binary) and ASCII mode. The transmission speed is up to 19200 bits/s.

Traffic on the MVI-MODBUS link is controlled by the master station. Direct communication is only possible between the master and the slaves.

You can find detailed technical information (function description, installation, configuration, maintenance, and technical data) about MODBUS I in AC 110 in
MVI - MODBUS Advant Controller 100 Series, User's Guide.

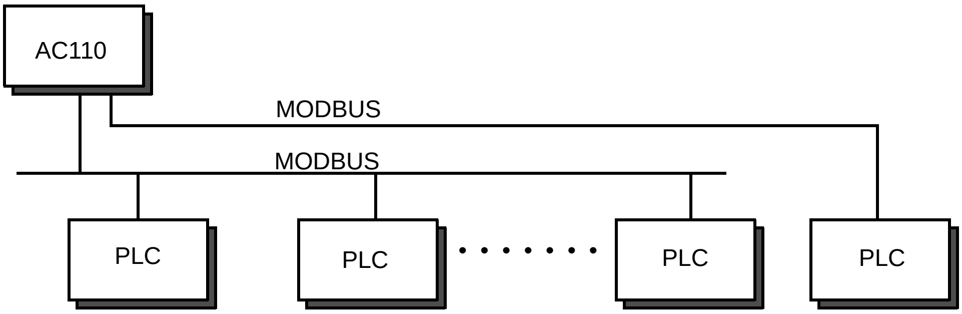


Figure 3-13. Example of an MVI-MODBUS Configuration

Guidelines

- MODBUS I using second serial interface at PM632, PM633 or PM634

  This is only possible if just one MODBUS channel is required and if RCOM option AC110 OPT5 SW is not used on the second serial interface of the processor module. Depending on how frequent data transfer is executed up to ca. 5% of the processor's capacity is required to control MODBUS. This solution is inexpensive since no MultiVendor Interface (MVI) CI532 is needed for MODBUS.
  Note that only MODBUS slave function with MODBUS address 1 is supported.
  See Section 3.1.7.1, Local Operator for calculation of MODBUS I data address.

- MODBUS I using submodule CI532V02 + submodule carrier SC610

  This solution should be chosen if the second serial interface of the processor module is used for RCOM option AC 110 OPT5 SW, MODBUS master function is needed or several MODBUS channels are required.

3.1.5.9 PROFIBUS-DP

Outline Description

PROFIBUS-DP is a fieldbus intended to connect Advant Controller 110 with remote I/O devices.

AC 110 acts as a master on PROFIBUS-DP and controls the dataflow on the bus. Direct communication between two masters connected via PROFIBUS-DP is not possible.

You need the processor module PM634 to utilize PROFIBUS-DP. It provides one PROFIBUS-DP master interface that conforms with norm EN 50170.

PM634 supports communication speeds up to 12 Mbit/s on the PROFIBUS-DP.

You can find detailed technical information (function description, installation, configuration, maintenance, and technical data) about PROFIBUS-DP in AC 110 in
Advant Controller 110 PROFIBUS-DP, User's Guide

All devices are connected in a bus structure (that is, line). For load reasons this bus is divided into so-called segments. Up to 32 stations (master or slaves) can be connected in one segment. The bus is terminated by an active bus terminator at the beginning and end of each segment.

To ensure error-free operation, both bus terminations must always be powered. Many vendors have designed a switchable bus termination in their devices or plug connectors. When more than 32 stations are used, repeaters (line amplifiers) must be used to connect the individual bus segments.

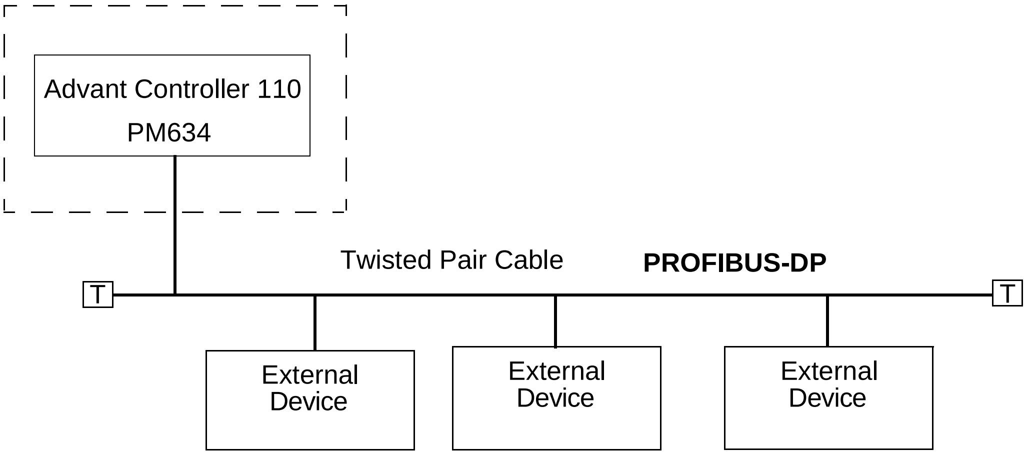


Figure 3-14. Example of an PROFIBUS-DP Configuration

The maximum distances that can be covered with PROFIBUS-DP depend on the used baud rate. Table 3-4 shows the maximum distances.

Table 3-4. Distances Based on Transmission Speed.

Baud Rate (kbit/sec)	9.6	19.2	93.75	187.5	500	1500	3000	6000	12000
Distance/Segment	1200 m	1200 m	1200 m	1000 m	400 m	200 m	100m	100m	100 m

3.1.6 Process Control

General

Advant Controller 110 offers powerful features covering all aspects of process control in most application areas. For information on the application language used, the principles of configuration/application building and the functional resources, see the following sections.

Appropriate Hardware and Software

For the available general function block library included in the basic system program and different additional software options, see Section 1.8, Product Overview.
You are also referred to information regarding necessary hardware and software given in other sections in this chapter. These sections are more focused on concrete functions.

Interface to Application Program

The controller data base is the normal interface to the application program.
For example, there are different data base elements representing process interface such as Analog Input, Digital Output, and so on. See Section Section 3.1.6.2, Principles of Application Building for more information.

General Guidelines

See Section 3.1.6.4, Guidelines for Application Building.

3.1.6.1 Application Language

Process control applications are programmed in the ABB Master Programming Language (AMPL), a function-block language with graphic representation which has been developed especially for process control applications.

You can program a controller in AMPL fully on-line, that is, with the programs running and controlling the process. If required, you can block part of a PC program, a complete PC program or the whole controller during programming. You can also develop programs off-line in an engineering station and load them into the controller at a later stage.

In addition to functional PC elements, AMPL contains a number of structural elements for division of a PC program into suitable modules which can be managed and executed individually. You can give the modules different cycle times and priorities so that both fast and slow control operations can be managed by the same PC program.

The inputs and outputs of an element are connected to the inputs and outputs of other elements or to process I/O points. Picking these elements and making these connections constitutes the programming work. The resulting PC program can then be documented graphically, as the figure below illustrates.

When a dedicated station is used for programming, it can be connected, either directly to the controller to be programmed, or indirectly via another controller in the communications network.

Signals are represented in engineering units throughout the whole application program.

This facilitates the configuration work, especially in connection to arithmetic operations. It also simplifies reading and understanding of the graphical documentation of the application program. Scaling of an I/O signal from an electrical variable, for example, 4 - 20 mA, to a variable expressed in engineering units is made in the data base for the point.

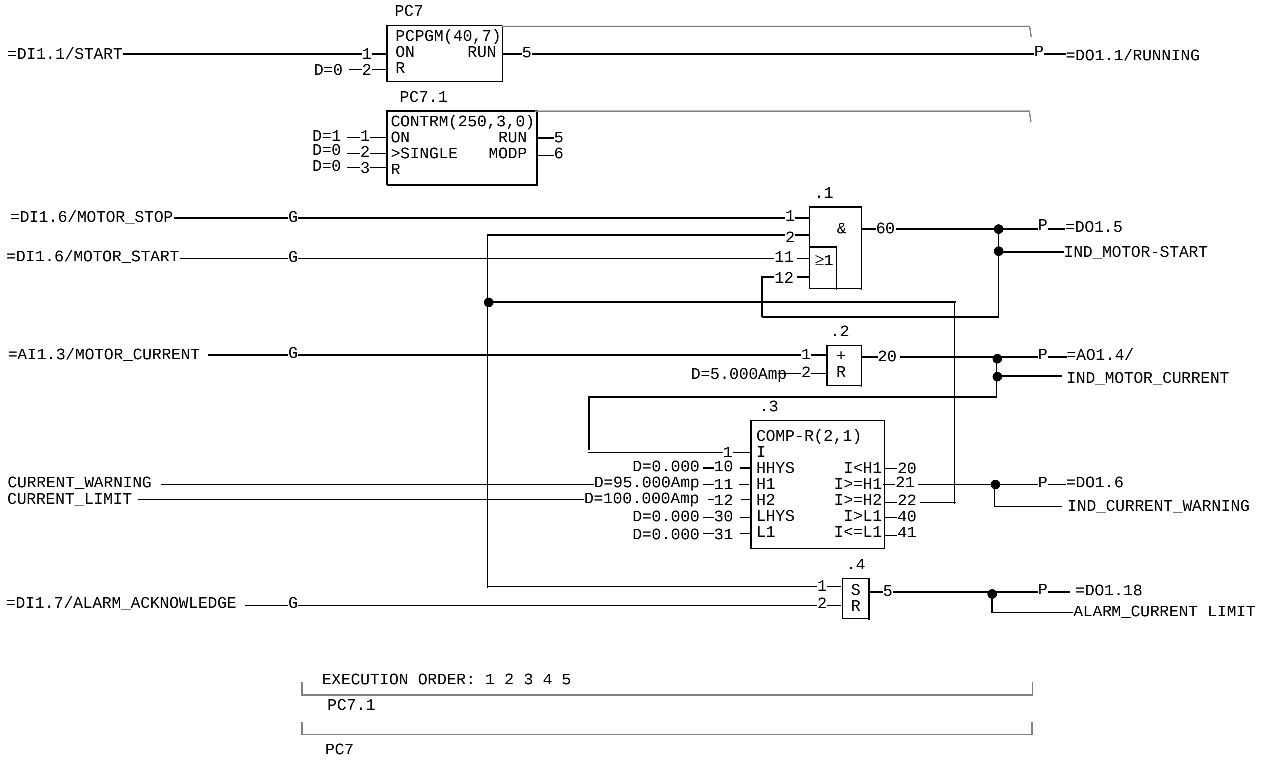


Figure 3-15. Example of PC Diagram of an AMPL Program

To boost application programming productivity even further, the engineering stations support the use of standard solutions to control problems that are repeated frequently in an application area or in a specific application project. For instance, a standard solution may comprise all the functions required to control motors of a certain type, or pumps, valves, temperature loops, and so on, including all the necessary data base definitions for I/O and operator communication.

For information about AMPL, see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

3.1.6.2 Principles of Application Building

Overview

Figure 3-16 illustrates how process signals available in the data base are linked to the AMPL application program.

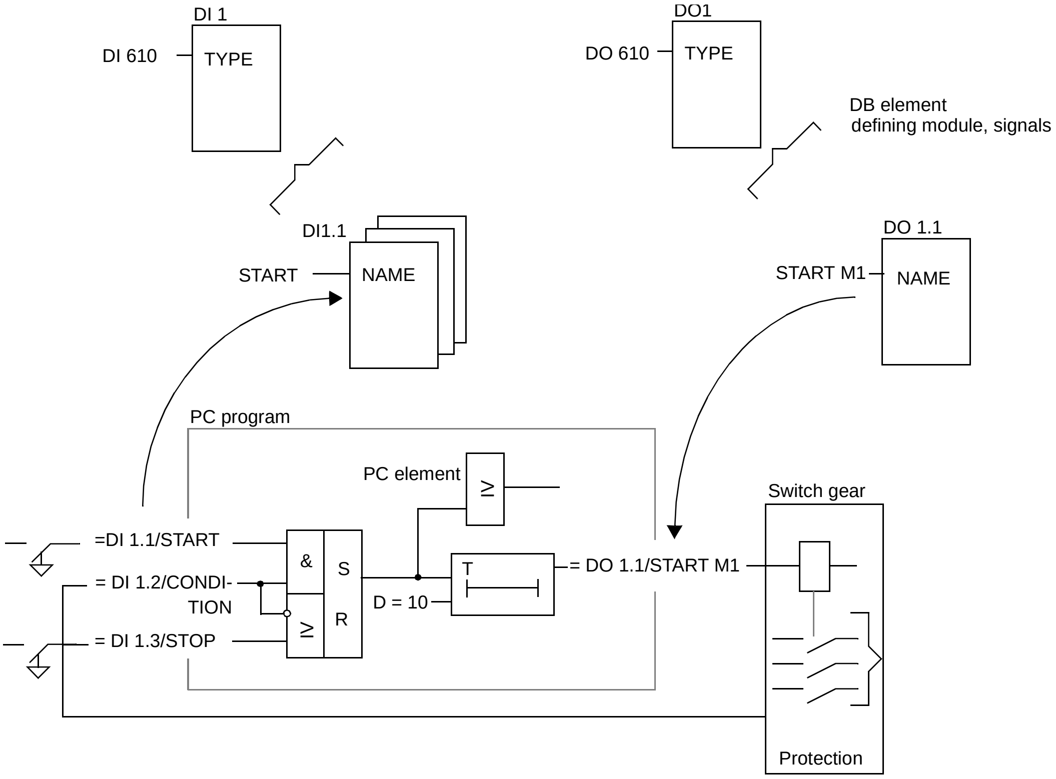


Figure 3-16. Simple Control Function Realized in AMPL

The user application program is the software you produce using predefined functions in the Advant Controller 110.

The user application program for the Advant Controller 110 consists of:

- DB elements of the related target, the configuration part
- PC elements of the related PC program, the program part.

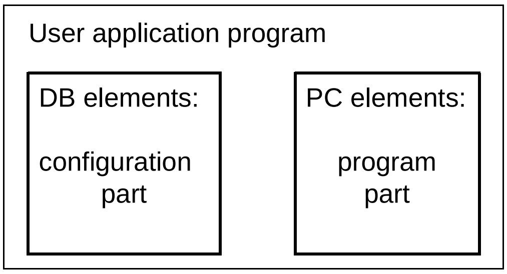


Figure 3-17. User Application Program for Advant Controller 110

Generation and Storage

You can generate and store a user application program for the Advant Controller 110 system in the engineering station.

The common way to create or modify a user application program for an Advant Controller 110 system is to use the **F**unction **C**hart **B**uilder (FCB) in the engineering station.

After you have generated a user application program, the target code representation of this application must be generated and then downloaded to the Advant Controller 110 station.

Configuration

An Advant Controller 110 station consists of a CPU module, a power supply and modules for process I/O and/or communication interfaces (see Figure 3-18).

The configuration part of a user application program contains the configuration elements of an Advant Controller 110 system:

- Hardware description
- Common data description
- Data exchange description.

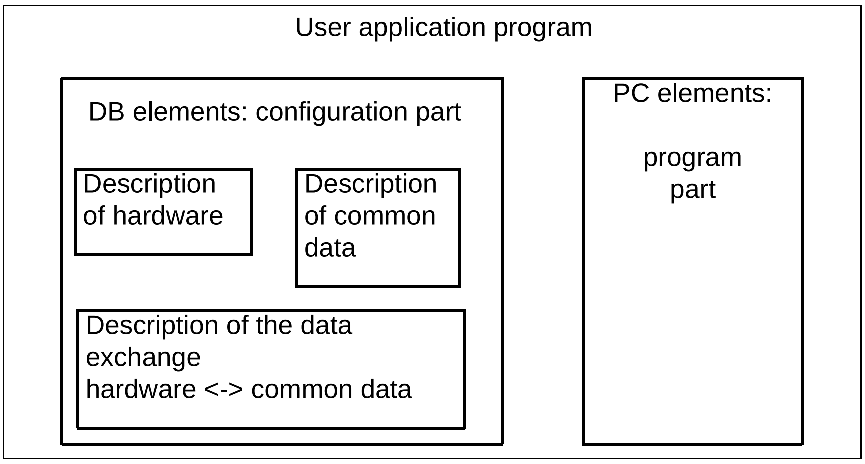

User application program
DB elements: configuration part
Description of hardware
Description of common data
Description of the data exchange hardware <-> common data
PC elements:
program part

Figure 3-18. Configuration Part Within the User Application Program

Configuration, DB Elements

DB elements in an Advant Controller 110 system describe:

- The hardware of the Advant Controller 110 system
  - Processor module
  - Process I/O
  - Digital input
  - Digital output
  - Analog input
  - …
- Communication interfaces
  - Backplane I/O bus extension
  - Connection to AF 100
  - …
- Common data elements
  - DAT(B)
  - DAT(I)
  - DAT(IL)
  - DAT(R)
  - PARDAT(B)
  - …
- Connection between the hardware and the common data elements
  - Data Set Peripheral DSP
- Event handling.

The DB elements are described in *Data Base Elements Advant Controller 100 Series Reference Manual.*

PC Program

The program part of a user application program describes the control algorithm and the control strategy. It contains the required PC elements, their interconnections and the connections to the DB elements.

This part of an Advant Controller 110 user application program is called the PC program.
It consists of the PCPGM header element and subordinated structure and basic PC elements.

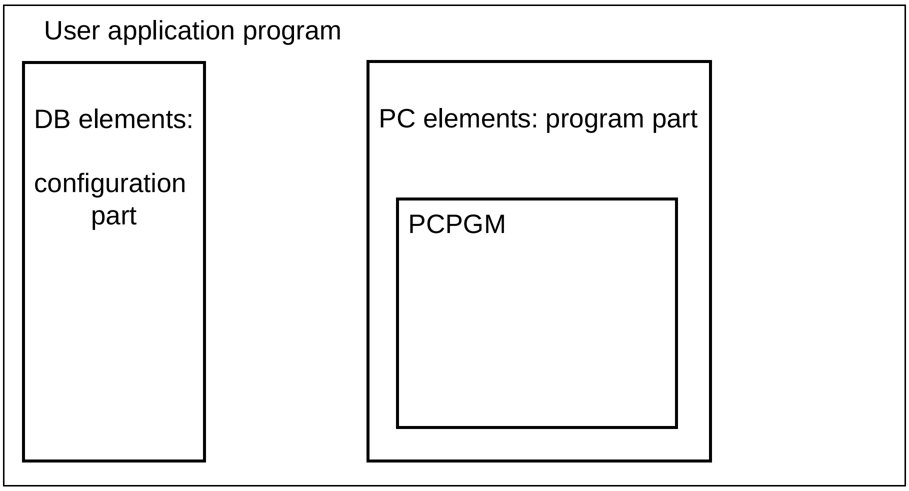


Figure 3-19. Program Part Within the User Application Program

PC Program, PC Elements in General

The fundamental unit of the PC part is the PC element:

• Basic element	The implementation of a complete function (for example, a counter element, a delay element, …)
• Structure element	A module header for a functional unit or an executable unit.

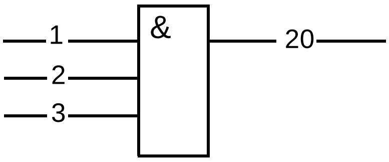


Figure 3-20. Example of PC Element in Graphical Representation

PC elements may have input and output terminals to interconnect them and to connect them to DB elements or constants. Each element is represented in a PC diagram by a graphic symbol designed to describe the function of the element.

PC Program, PC Diagram

The PC diagram is the usual representation of a PC program. The PC diagram is a graphical representation of the PC elements and their interconnections.

For creation and modification of PC elements and their interconnections, the engineering stations contain an editor in PC diagram representation (function chart representation).

For documentation, PC diagrams can be generated by the engineering station.

PC Program, Executable Unit

A PCPGM on an Advant Controller 110 system is divided into executable units.
Every executable unit acts with its own scheduling parameters, for example, with its own cycle time.

In Advant Controller 110 the following executable units exist: CONTRM, MASTER, SEQ and the PCPGM.

3.1.6.3 Control Functions

The main built-in control functions available for application building are grouped and presented briefly below. Most of the functions are supported by PC elements, that is, the PC elements are the base of the functionality of the Advant Controller 110.

For a listing of those PC elements included in the basic system program module and the different optional program modules, see Section 1.8.2.2, Functions of BASE Software and Software Options.
For detailed function descriptions of the different PC elements, see *PC Elements Advant Controller 100 Series Reference Manual*.

Logic and Time Delays

- Basic Boolean functions
- Composite Boolean functions
- On/off delay, pulse generation.

Sequence Control

- General structuring functions
- Sequence control influenced by standard IEC 848.

Calendar Time Functions

Date and time can be used when an automatic function shall be started or when a report is printed out.

Arithmetic

Standard arithmetic expressions as well as special functions are available.

Pulse Counting and Frequency Measurement

These functions are used for different applications in the industry, such as position measurement, flow measurement, speed measurement, synchronization of machine movements, and so on.
The pulse-counting function requires special hardware.
You can use the pulse counter module DP620.

Supervision

Any logic state transition in the process or application program, or any limit transition of a process variable or calculated variable, can be defined as a point of event.

Events can be time-stamped with a resolution down to 1 ms, which enables you to perform excellent analyses of cause and effect in complex situations.

Measuring

You can connect process variables with different electrical representations as follows:

- Standard signal types, for example, 4 - 20 mA, 0 - 10 V, and so on
- Pt 100, thermocouple
- Pulse, frequency.

Pre-filtering is important in digital systems to obtain interference-free control and logging.
The irrelevant frequency content in the process signals must be limited.
Standard signals for current and voltage are pre-filtered in steep active hardware filters whereas temperature measurement signals are filtered by integrating A/D conversion. In addition to hardware filtration, the software can select digital filtration with single pole filters and with the required break frequency.

In the case of temperature measurement, linearization is performed in accordance with the type of Pt 100 transducer or thermocouple selected.

Feedback Control

Powerful functions for feedback control are provided with a great number of PC elements. Examples of PC elements are:

- P, **P**roportional regulator
- INT, **Int**egrator
- DER, **Der**ivator
- PI, **P**roportional **I**ntregrating regulator
- PIP, **P**roportional **I**ntregrating **P**roportional regulator
- PDP, **P**roportional **D**erivating **P**roportional regulator
- CON-PU1, **Con**troller - **Pu**lsed **1**
- RAMP, **Ramp** generator.

3.1.6.4 Guidelines for Application Building

This section is not intended to be a formal guide to application programming but rather a collection of suggestions and ideas for program design and structuring. The following are general rules for program design:

- Structure the application program (see below).
- Write programs that are as readily understandable as possible.

- Avoid “smart” programming unless absolutely necessary to achieve the necessary performance.
- Prepare a draft PC diagram in which the required function is built up with the help of PC elements.
- Use the largest elements possible.
- Use the most powerful elements possible.
- Use the principles of typical solutions (type circuits).

Structuring of the Application Program

When structuring the application program, you must satisfy these three requirements:

- Structuring in accordance with the structure of the plant and the process.
- Structuring in accordance with execution time.
- Function orientation from the typical solution aspect.

The structure elements primarily used are PCPGM, CONTRM and FUNCM. SEQ and STEP are also used with sequential control.

The elements PCPGM, CONTRM and SEQ are execution-controlling. You can activate and deactivate these elements from outside—do this when high performance is required. The elements are only activated when execution of the subsidiary program (-section) is necessary.

Place the activation and deactivation for the execution control in a software module with a short cycle time. Note, however, that there may be occasions such as at start, stop and emergencies when you must run all programs (-parts) simultaneously. If there are such occasions, they determine how hard the controller can be utilized.

Use the following as rules of thumb when structuring:

- Do not place the whole application in just one control module.
- It is preferable that you place independent parts of the application program which have no data exchange or a limited data exchange in different control modules.
- A control module (CONTRM) delimits a function to which a special cycle time is applied.
- A function module (FUNCM) delimits a function consisting of several control modules or divides a control module into subfunctions.
- Don‘t use more than three levels with structure elements except in special cases.
- Use BLOCK elements to close part of a control module when reducing the load on the controller.

NOTE

Writing to the data base continues while the blocking is active.

Use a simple pin diagram when you are structuring the application program.

3.1.7 Operator's Interface

3.1.7.1 Local Operator

Appropriate Hardware and Software

Communication with a local operator station / MMI is an application of MODBUS I. See Section 3.1.5, Communication.

You can connect panels or a personal-computer-based operator station directly with cable via RS-232-C serial interface at connector 2 on the front of PM632, PM633 or PM634 module.

No additional communication interface modules are necessary.

You need software option OPT4 which provides Modbus protocol on the second serial interface of PM632, PM633 or PM634 module.

Physical Connection

You can use following serial interface for connection with local operator station, MMI or panel:

- Connector:
  Connector 2 (RS-232-C) on the front of PM632, PM633 or PM634
- The LINE characteristics:
  9600 baud rate; 1 start-bit, 1 stop-bit; no parity.

To establish the RS-232-C connection between the local operator station / MMI and AC 110, just plug the connection cable into the RS-232-C connector of the personal-computer-based operator station and connector 2 in the front of PM632, PM633, or PM634 module.

Communication with Local Operator Station

The local operator station communicates with Advant Controller 110 via the MODBUS I protocol (binary). With Advant Controller 110, it can only be used as a point-to-point network (because of the RS-232-C). The master of this communication link is on the operator station / MMI side.
The Advant Controller 110 is the slave with a fixed slave node number 1.

Access

The following DB elements are accessible by the local operator station:

• Boolean Parameters	PARDAT(B)
• Integer Parameter	PARDAT(I)
• Integer Long Parameter	PARDAT(IL)
• Real Parameter	PARDAT(R)

All signals of an application on an Advant Controller 110 to be accessed by the operator station must be reflected as PARDAT. On an Advant Controller 110, it is only possible to read or write to and from memory. Direct access to input or output is not supported.

The MODBUS I address can be calculated as follows:

Bit addresses: $ADDR = n * 32 - m$
Integer addresses: ADDR = (n-1) ∗ 2 + m

Where *ADDR* is the Modbus address,
n is the item designation of the PARDAT element
(example: *n* = 3 for PD3),
m is the offset in the PARDAT element, starting with 0
(example: *m* = 8 for bit number 9 in a PARDAT (B)).

Communication Protocol

The communication protocol for data exchange between the Advant Controller 110 and local operator station / MMI is the standardized MODBUS I protocol.
The following MODBUS functions are supported:

Table 3-5. MODBUS Functions

Func. Code	MODBUS Function	Data Access in AC110
01	Read coil status	One bit in a PARDAT(B)
02	Read input status	One bit in a PARDAT(B)
03	Read holding register	One word in a PARDAT(I), PARDAT(IL) or PARDAT(R)
04	Read input register	One word in a PARDAT(I), PARDAT(IL) or PARDAT(R)
05	Force single coil	One bit in a PARDAT(B)
06	Force single register	One word in a PARDAT(I), PARDAT(IL) or PARDAT(R)
07	Read exception status	Get AC 110 status
08	Read diagnostic counter	Get internal counters on AC 110
15	Force multiple coils	Bits in a PARDAT(B)
16	Force multiple registers	A number of word in a PARDAT(I), PARDAT(IL) or PARDAT(R)

The function codes 1 and 2, as well as 3 and 4, work identically when reading from the internal memory. The function codes 1, 2, 3, 4, 7 and 8 are not allowed for broadcasting when the Advant Controller 110 is a slave.

3.1.7.2 Central Operator

Appropriate Hardware and Software

Communication with a central operator's station, AdvaSoft for Windows, is possible via Advant Fieldbus 100. See Section 3.1.5, Communication.

To support AdvaSoft for Windows you need Advant Controller 110 software option OPT2 which provides event handling.

Beside Advant Controller 110 software option OPT3 which provides event handling you need no additional software options to support AdvaSoft for Windows.

The operation station products are described separately.
For information about AdvaSoft for Windows, see *AdvaSoft for Windows, User's Guide.*
For information about Advant Fieldbus 100, see *Advant Fieldbus 100 User's Guide*.

3.1.8 Heat Dissipation

3.1.8.1 Cabinet Ventilation

To avoid overheating, when ambient temperatures are high, take into consideration the heat dissipated in the electronics cabinet. This is particularly important with sealed cabinets (IP54) or tropicalized cabinets (IP41) with considerable circuit board equipment and ambient temperatures at levels approaching 40°C.

The frequency of faults is estimated to be doubled for each 20°C increase in temperature.
It is, therefore, important to maintain as low a temperature as possible where the equipment is installed.

The different hardware modules in the controller and the I/O system have different outputs of heat. Accurate calculation of the heat produced by the system requires knowledge of the modules and the work cycle.

3.1.8.2 Heat Dissipation Permitted in Cabinets

The maximum permitted temperature above the subracks in the cabinet is 55°C. The permissible amount of heat generated depends on the type of cabinet and its location.

Table 3-6 indicates the heat generated to give a 15°C temperature rise and a 30°C temperature rise in the cabinets.

Note that there is normally no requirements for fans in an Advant Controller 110.

The standard design and assembly of cabinets aim to give a maximum of 15°C temperature rise within the cabinet, which results in a maximum permitted ambient temperature of 40°C (55°C - 15°C).

In critical applications with subracks fully equipped and cabinets arranged in groups, you may need to make a calculation of the actual power dissipation and an estimation of the temperature rise within the cabinet. Calculation is recommended at system enlargement too.

Some data to be used in calculations is given below. You can find information about power dissipation for different hardware modules in *S600 I/O Hardware Reference Manual*.
Cabinets including a single subrack normally have no temperature rise higher than 15°C, irrespective of the disposition of the subrack, cabinet type and location of the cabinet.

.

Table 3-6. Permitted Power Dissipation for RM500

Protection Class	15° C Temperature Rise	30° C Temperature Rise
IP21	700 W	1.400 W
IP41	500 W	1.000W
IP54	300 W	600 W

The CPU subrack is provided with a fan unit to equalize the temperature difference in the subrack.

3.1.8.3 Cabinets in Groups

When cabinets are installed in groups, reduce the permitted power dissipation in accordance with Figure 3-21. The permitted power dissipation in a particular cabinet is the power specified in Table 3-6 multiplied by a factor from Figure 3-21.

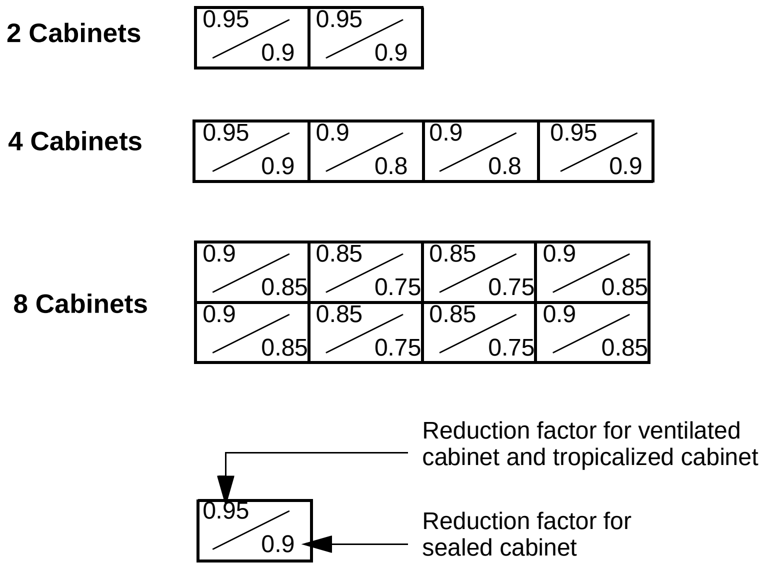


Figure 3-21. Reduction Factors for Cabinets Installed in Groups

3.1.8.4 Calculation of Heat Generated in a Cabinet

When you are calculating the heat generated in a cabinet, add up the heat generated by the different hardware modules. To this sum, add the heat generated by the power supply units and other equipment such as an extra modem, extra unit for supply of power to transmitters, and so on.

See *S600 I/O Hardware Reference Manual* for current consumption and for the power dissipated.

A power supply unit located beneath the subracks contributes to the total power dissipation with 100 W. Do not include redundant power supply units in the calculation of number of units because of the load shedding.

The total power dissipated in the cabinet can be written as follows:

$$P_{Total} = \sum P_{C-module} + \sum P_{IO-module} + \sum P_{Voltagesupplyunit} + \sum P_{Sundry}$$

3.1.9 Module Types and Programming Style

From a maintenance viewpoint, use as few module types as possible in the hardware disposition of a control system. This is most relevant with the process I/O design. Standardization of I/O signal types and other electrical qualities is important to minimize the spare part stock.

If possible, do not use "smart programming" when you make an application program. Your solutions must make sense to the maintenance people in the event of disturbances and following trouble-shooting.

3.1.10 Expansion Possibilities and Spare Considerations

Expansion Possibilities

You can connect a new Advant Controller 110 to an existing Advant Fieldbus 100 control network. The new controller is automatically incorporated in the communication system.

You can expand the controller step by step, that is, the system can be enlarged and made more complex in different ways. Examples of such areas are:

- Process I/O
- Communication with external computers and other systems
- Operator functions
- Application program
- Redundancy.

Of course there are some limitations such as maximum number of possible instances and functionality offered by the available library. You can, install additional software options if certain optional functions are required.
For limitations, see Section 3.2, Capacity and Performance.

If desirable, you can carry out most expansions and operations on-line.
You can expand your application program with additional PC- or DB-elements on-line. No extra preparation like dimensioning an number of spare instances in the data base or spare PC program structures is necessary. You need just enough memory in the CPU module for the complete application program.
Extensive reconfiguration and enlargement of the system is normally linked to revamping the plant. Shut-down of the system and off-line work is then advisable.

Spare Considerations

In addition to what is said above regarding memory for additional application programs, there is a simple rule of thumb for hardware design:

You can add new I/O modules on-line. It is practical to keep approximately 10% to 20% of the channels spare. The same recommendation is valid for spare space in subracks.

3.1.11 Availability and Security

Many factors affect the reliability and availability of a control system. Redundancy is perhaps the first thing to reflect upon, but it is never the most important factor. Basic system properties of ABB Master are, in general, more important.
ABB Master is designed to satisfy extreme demands for reliability, availability and security. For further discussion of various aspects of reliability, availability and security, see separate documentation. Some keywords follow:

- Solid mechanical and electrical construction
- Security against electrical interference
- High-quality components
- Well-tested electronic units
- Thoroughly developed and tested modular software
- Easily interpreted program language for application programs, AMPL
- Complete documentation
- Integral supervision and diagnostic functions
- Powerful tools for testing
- On-line replacement of faulty hardware units
- After-sale service
- Redundancy.

For descriptions of the provided diagnostics, see Section 5.4.2, Fault Tracing Procedure. The behavior of process outputs is described in Section 3.1.11.1, Process Outputs Behavior at Interruptions.

Below you can find information regarding security and the possibilities of redundancy in the Advant Controller 110.

3.1.11.1 Process Outputs Behavior at Interruptions

From the viewpoint of security, the behavior of the control outputs to the process in connection to ordered or unintentional interrupts and faults is very important.
ABB Master has a straightforward philosophy: all process outputs are controlled to zero and relay outputs are de-energized.
Unintentional interrupts are caused, for example, by the following events:

- Fault in central processing unit and memory
- Loss of power supply
- Fault in power supply
- Fault in parallel bus communication (backplane bus).

In spite of the fact that an Advant Controller 110 is a very reliable system, reset of outputs to zero cannot be guaranteed during all conditions. Always assume a combination of errors or an incorrect system handling which can cause an output to behave in an unexpected way. This is of great importance when it comes to personnel safety and preventing expensive technical equipment from being damaged.

3.1.11.2 Duplication for Security

Duplication of control system functions is one way to ensure that all tasks are performed correctly. It is, however, very important to emphasize that the security in a process control system, when it comes to personnel safety, must never be based on duplication of system functions alone. You must always consider other measures as well.

3.1.11.3 Redundancy

In general, redundancy is not supported except the following subsystems and functions:

- Mains distribution network
- Voltage supply, 24 V
- MasterFieldbus (cable redundancy)
- Advant Fieldbus 100 (cable redundancy).

You can add redundancy within a specific controller in a flexible way to meet the desired demands upon system availability.

The controller utilizes different principles of redundancy for included subsystems. Both hot stand-by and independent parallel operation are used. Duplicated hardware is primarily used in what is known as 1:1 implementation.

Maintainability is always provided by diagnostics, fault announcement and adequate unit exchangeability. For short descriptions regarding certain redundant functions, see below.

Mains Distribution Network

Redundant a.c. networks, or a combination of an a.c. network and a d.c. network, are primarily connected to separate circuit breakers and power supply units. Secondarily, at 24 V level, the two networks are wired by diodes. The controller always needs an a.c. supply for use by certain external equipment such as modems, and so on. In the case of redundant a.c. networks, automatic relay devices are used to maintain the power supply in case of a single network error. The duplicated equipment is normally in parallel operation, sharing the load. In the event of a single failure, the full responsibility is taken over bumplessly by one piece of equipment.

Power Supply, 24 V

Duplicated power supply units for 24 V d.c., secondarily wired by diodes, are utilized. This is the same redundancy solution as for mains distribution network.

MasterFieldbus

The communication to a remote unit can be equipped with transmission media redundancy. This includes:

- One communication interface submodule in the controller
- Two cables including duplicated modems
- One remote unit.

Advant Fieldbus 100

Transmission media redundancy is possible using CI626V01 or CI627.

3.1.12 Memory Calculation

Advant Controller 110 provides sufficient RAM for most applications. The Advant Controller 110 processor module PM632 provides 512 kbytes, the modules PM633 and PM634 provide 1 Mbyte of flash PROM and RAM for storage of the application code and configuration data. During runtime of the application, the code and configuration data is copied from flash PROM into the RAM of the processor module. Additional RAM is required for the necessary data areas for intermediate data storage.

The amount of free RAM is dependent on the number and type of options actually loaded into the system. Typically, the free RAM size is approximately 220 kBytes (PM632) up to 720 kbyte (PM633/PM634).

You can get the exact memory requirement for the PC section of your application program by the Function Chart Builder command **PC Section | Memory Calculation**.

Once the application is prepared and downloaded to the target, you can obtain an exact report about free memory resources on the target via the *Status Report* window. This function considers PC and DB part of your application.

During the execution of an *on-line change*, extra RAM is needed. If the memory is already consumed by a big application, you are alerted by the Function Chart Builder running on the engineering station with the warning, “Not enough memory on target available”.

The memory requirement for each PC or DB element you will find in the following manuals:

- *PC Elements Advant Controller 100 Series Reference Manual*
- *Data Base Elements Advant Controller 100 Series Reference Manual*.

NOTE

For a rough but quick memory calculation of your application program, see Section 3.1.12.1, Rough Estimate of AC 110 Memory Demand (5-step Method).

3.1.12.1 Rough Estimate of AC 110 Memory Demand (5-step Method)

NOTE

The result of this method is only a rough estimate which can be made in a reasonable amount of time and before your real application programming is ready.

Step 1

Calculate the required “PC element statement” size and “local data” size for your CONTRMs according to the formulas and data given in the *PC Elements Advant Controller 100 Series Reference Manual*.

Step 2

Calculate the memory demand for the connections in your application.
For each CONTRM, the signals into the CONTRM must be respected.
Use 2 bytes for each B or I signal, use 4 bytes for each IL,R,T or TR signal.

Step 3

Calculate the required amount of "configuration data," "common data description," "common data," "common data extended" and "common data event queue" according to the formulas and data given in the *Data Base Elements Advant Controller 100 Series Reference Manual*.

Step 4

Reserve 10 bytes extra for each signal into or from the CONTRM.

Step 5

Calculate the total memory from the sum of all step 1 to step 4 partial results.

3.1.13 CPU-Optimization, Load Calculation

This section deals with the program execution capacity of an Advant Controller 110. It provides answers to questions such as, "What can I expect the load generated by my application to be?" It also provides a survey of how the application program influences the load on an Advant Controller 110. In conclusion, you can find recommendations for the reduction of system load.

The performance of an Advant Controller 110 depends on the CPU load of the application program. The CPU load of an application program is determined by

- CPU load of all executable units (PCPGM, CONTRM, MASTER, SEQ)
- CPU load of Data Set Peripheral communication (DSP) on the Advant Fieldbus 100
- CPU load of MVI data block communication (MVB)
- CPU load of event detection.

Priority Levels

The different functions in an Advant Controller 110 are allocated different priorities.
This means that a function with a higher priority takes precedence over a function with a lower priority if both functions are activated simultaneously. A schematic presentation of the priority system follows:

The user is not normally concerned with priority levels since these are managed automatically by the system, but the user should be aware of the priority system and that the system might stall if the system is heavily loaded.

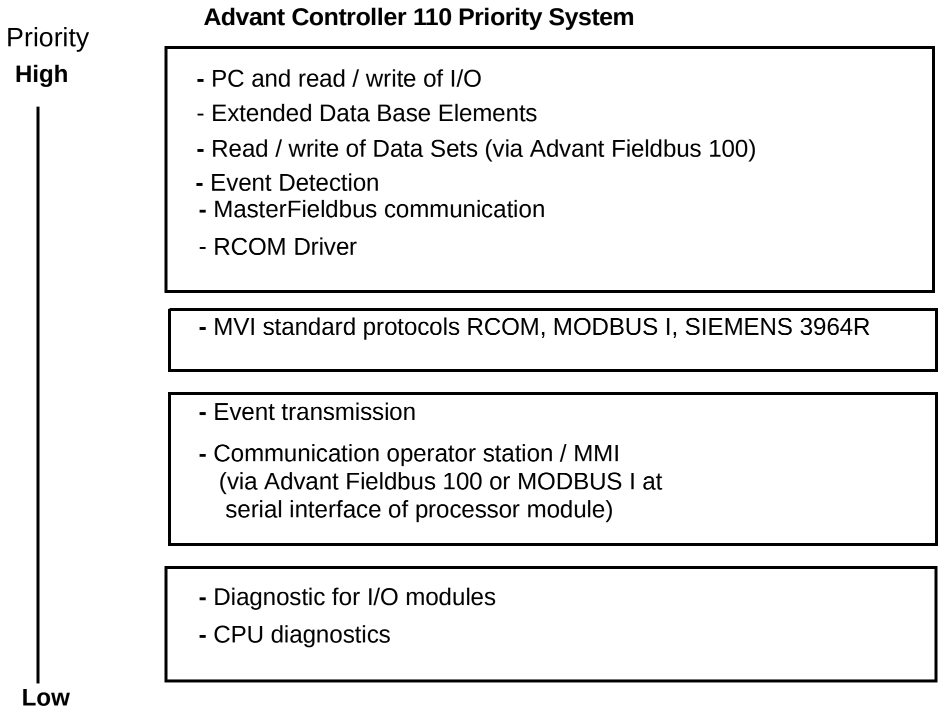

Advant Controller 110 Priority System
Priority
High
Low
- PC and read / write of I/O
- Extended Data Base Elements
- Read / write of Data Sets (via Advant Fieldbus 100)
- Event Detection
- MasterFieldbus communication
- RCOM Driver
- MVI standard protocols RCOM, MODBUS I, SIEMENS 3964R
- Event transmission
- Communication operator station / MMI (via Advant Fieldbus 100 or MODBUS I at serial interface of processor module)
- Diagnostic for I/O modules
- CPU diagnostics

Figure 3-22. Advant Controller 110 Priority System

3.1.13.1 CPU Load of Executable Units

The CPU load of executable units (PCPGM, CONTRM, MASTER, SEQ) is determined by the execution time of the executable units and their cycle time.

To isolate each executable unit from data change during execution, the execution is commenced by an input phase and ends with an output phase. This data exchange is performed by GET elements for the input phase and PUT elements for the output phase. The PUT and Get elements are internal function blocks of AC 110.

The execution time of an executable unit of type CONTRM, MASTER or SEQ consists of

- Execution time of the module header element CONTRM, MASTER or SEQ
- Execution time of all PC elements included in this executable unit
- Execution time of GET and PUT elements for the input and output phases.

You can find the execution time of all PC elements including module header elements in the *PC Elements Advant Controller 100 Series Reference Manual.*

To reduce load for certain PC elements (for example, AND, OR, SR or XOR) in-line code is automatically chosen by the engineering tool. Note that for every in-line code sequence, the execution time of the in-line begin and end element must be added. You can find the execution time of these PC elements including in-line begin and end elements in *PC Elements Advant Controller 110 Reference Manual.*

The execution time for a single PC element or for all PC elements within a module or block can be automatically computed by the **PC-Section | Computing Time | Unit** and **PC-Section | Computing Time | Element** commands of the Function Chart Builder running on the engineering station. Reduction of execution time due to in-line coding of PC elements (for example, AND, OR, SR and XOR) is not taken into account by these Function Chart Builder commands.

Every connection of a PC element terminal to any of the following terminals causes the execution of a GET or PUT element:

- DB element terminal
- Terminal of a PC element within another executable unit.

If more than one PC element terminal within a certain executable unit is connected to the same DB element, only **one** GET or PUT element is executed.

The execution times of GET and PUT elements for connections to all kinds of DB element terminals are listed in the *DB Elements Advant Controller 110 Reference Manual*.

An executable unit including the module header element, PC elements, and GET and PUT elements is executed with the cycle time specified by the first call parameter (*C1*) of the module header element (CONTRM, MASTER or SEQ).

The CPU load L_{exec} (in%) of all executable units can be calculated by the following formula:

$$L_{exec} = \sum_i \frac{N_i \cdot T_i}{C_i} \cdot 100\%$$

where

T_i = execution time of function *i* (in ms)

N_i = number of function *i*

C_i = cycle time of function *i* (in ms).

The functions are:

- PCPGM
- Module header elements CONTRM, MASTER, SEQ
- PC elements
- GET and PUT elements.

The cycle time T_c depends on the element:

• PCPGM	Own cycle time (call parameter C1)
• Module header element (CONTRM, MASTER, or SEQ)	Own cycle time (call parameter C1)
• PC element	Cycle time of the executable unit including this PC element
• GET or PUT element	Cycle time of the executable unit including this element.

3.1.13.2 CPU Load of Data Set Peripheral Communication

The CPU load L_{DS} of Data Set Peripheral communication depends on the number of Data Set Peripheral elements (DSP), their cycle time and the number of DAT elements referenced by those Data Set elements.

The execution time T_{DS} of a Data Set Peripheral (in ms) can be calculated by one of the following formula.

for PM632:

$$T_{DS} = 0{,}150 + n_{DAT} \cdot 0{,}035$$

for PM633 and PM634:

$$T_{DS} = 0{,}08 + n_{DAT} \cdot 0{,}018$$

where

n_{DAT} = number of DAT elements (1 - 8) referenced by Data Set

The CPU load L_{DS} (in %) of Data Set Peripheral communication can be calculated by the following formula:

$$L_{DSP} = \sum_{i} \left(\frac{2 \cdot T_i}{C_i} + \frac{0{,}01}{C_{PCPGM}} \right) \cdot 100\%$$

where

T_i = execution time of DSP i (in ms)

C_i = cycle time of DSP i (in ms), see terminal CYCLETIM

C_{PCPGM} = cycle time of executable unit PCPGM

In addition to the load limitation, the following constraint **must be fulfilled**:

$$\sum_{i} T_i < C_{min}$$

where

T_i = execution time of DSP *i* (in ms)

C_{min} = smallest cycle time of all DSP *i* (in ms), see terminals CYCLETIM

CAUTION

If this constraint is not fulfilled, the CPU can be overloaded no matter what the calculated CPU load is! Overloading means that your Advant Controller 110 stalls.

You can find some examples of CPU load calculations for Data Set Peripheral communication in Table 3-7 and Table 3-8 for PM632.

Table 3-7. CPU Load from Data Set Peripheral Communication for PM632, Example 1

Number of DSP Elements	**Number of DATs per DSP** n_{DAT}	**Cycle Time of DSP** C_i **(in ms)**	**Execution Time of DSP** T_i **(in ms)**	**Cycle Time of PCPGM** C_{PCPGM} **(in ms)**	**Load** L_{DSP} **(in %)**	**Constraint** $\sum_i T_i < C_{min}$
4	4	**16**	0.29	16	15	
10	8	64	0.43		14	
				Sum	29	5.4 < **16**

Table 3-8. CPU Load from Data Set Peripheral Communication for PM632, Example 2

Number of DSP Elements	**Number of DATs per DSP** n_{DAT}	**Cycle Time of DSP** C_i **(in ms)**	**Execution Time of DSP** T_i **(in ms)**	**Cycle Time of PCPGM** C_{PCPGM} **(in ms)**	**Load** L_{DSP} **(in %)**	**Constraint** $\sum_i T_i < C_{min}$
200	8	**512**	0.43	512	34	86 < **512**

3.1.13.3 CPU Load of MVI Data Block Communication

For a description of how to calculate the CPU load of MVI data block communication, see *RCOM Advant Controller 100 Series User's Guide.*

3.1.13.4 CPU Load of Event Detection

Data base elements AIC and DIC configure event detection for PC signals connected to the terminal VALUE of these data base elements. (Data base elements AIMVB and DIMVB configure the conversion of events received in MVI Data Blocks from MasterPiece 40 into the internal event format.)

To every data base element AIC, DIC, AIMVB and DIMVB, a system function is assigned which executes event detection. The CPU load of these event detection functions is determined by their execution time and cycle time.

The execution time of the event detection functions, depending on the kind of data base element, is listed in the *DB Elements Advant Controller 110 Reference Manual*. The cycle time of these functions equals the scan time for event detection (specified by the terminal SCANT).

The CPU load L_{event} (in%) of event detection can be calculated by the following formula:

where

T_i = execution time of event detection function i (in ms)

$$L_{event} = \sum_i \frac{T_i + 0{,}1ms.\left(\frac{S_i}{S_{min}} - 1\right)}{S_i} \cdot 100\%$$

S_i = scan time of event detection function i (in ms), see terminal SCANT of the corresponding AIC, DIC, AIMVB and DIMVB element

S_{min} = smallest scan time of all event detection function i (in ms), see terminals SCANT of **all** AIC, DIC, AIMVB and DIMVB elements.

In addition to the load limitation, following constraint **must be fulfilled**:

$$\sum_i T_i < S_{min}$$

where

T_i = execution time of event detection function i (in ms)

S_{min} = smallest scan time of all event detection functions (in ms), see terminals SCANT of **all** AIC, DIC, AIMVB and DIMVB elements

CAUTION

If this constraint is not fulfilled, the CPU can be overloaded no matter what the calculated CPU load is! Overloading means that your Advant Controller 110 stalls.

Consider that one event detection function with a very small scan time increases the load for all **other** event detection functions drastically (see example 1 and 2 in Table 3-10).

The following examples for load calculation use T_i values according to Table 3-9. For more information about execution times see *DB Elements Advant Controller 100 Series Reference Manual*.

Table 3-9. Execution Time of Event Detection Functions

Call Name	Execution Time T_i (milliseconds) PM632	Execution Time T_i (milliseconds) PM633/PM634
AIC	3.2	2.0
DIC	0.8	0.5

You can find some examples of CPU load calculations for event detection in Table 3-10.

Table 3-10. CPU Load of Event Detection for PM632, Examples

Event Detection Functions			**CPU Load (in %)** L_{event}	**Constraint** $\sum_i T_i < S_{min}$
32 DIC, SCANT=640ms			3	19 < 640
31 DIC, SCANT=640ms	1 DIC, SCANT=40ms		10	19 < 40
16 AIC, SCANT=640ms	16 DIC, SCANT=640ms		8	50 < 640
32 AIC, SCANT=640ms	16 DIC, SCANT=640ms	16 DIC, SCANT=160ms	22	99 < 160

Note that the load calculation considers the worst case. The worst case appears when all event detection functions detect an event or even several events (AIC element) at the same time. While no events are detected, the CPU load is much lower but you must not rely on that. Otherwise an event shower might overload your Advant Controller 110 and, hence, stall it.

3.1.13.5 CPU Load of Extended Data Base Elements

See *AMPL Configuration Advant Controller 100 Series Reference Manual* and *Data Base Elements Advant Controller 100 Series Reference Manual* for description of extended data base elements.

To every extended data base (DB) element a system function is assigned which executes the element. The CPU load of these system functions is determined by their execution time and cycle time.

The execution time of the extended DB elements are listed in the *Data Base Elements Advant Controller 100 Series Reference Manual*.

The CPU load L_{XDB} (in %) of extended DB elements can be calculated by the following formula:

$$L_{XDB} = \frac{4,2ms}{S_{min}}.100\ \% + \sum_i \frac{T_i}{S_i} \cdot 100\%$$

where

T_i = execution time of extended DB element i (in ms), see table below

S_i = scan time of extended DB element i (in ms), see terminal SCANT of the corresponding extended DB element

S_{min}= smallest scan time of all extended DB elements (in ms), see terminals SCANT of **all** extended DB elements.

Consider that one extended DB element with a very small scan time increases the load significantly.

In addition to the load limitation, following constraint **must be fulfilled**:

$$\sum_i T_i < S_{min}$$

where

T_i = execution time of extended DB element i (in ms)

S_{min} = smallest scan time of all extended DB elements (in ms), see terminals SCANT of **all** Extended DB elements.

CAUTION

If this constraint is not fulfilled, the CPU can be overloaded no matter what the calculated CPU load is! Overloading means that your Advant Controller 110 stalls.

Table 3-11. Execution Time of Extended Data Base Element

Extended DB Elements	Execution Time T_i (milliseconds) PM632		Execution Time T_i (milliseconds) PM633/PM634	
	Standard Configuration	Worst Case	Standard Configuration	Worst Case
AIS	0.3	1.4	0.2	0.9
AOS	0.4	1.3	0.2	0.8
DIS	0.2	1.2	0.08	0.7
DOS	0.2	0.9	0.07	0.6
MB	0.4	0.8	0.02	0.5
MI	0.02	0.02	0.01	0.01
MIL	0.02	0.02	0.01	0.01
MR	0.02	0.02	0.01	0.01

3.1.13.6 Calculation of Total CPU Load

The total CPU load L can be calculated by the following formula:

$$L = L_{exec} + L_{DS} + L_{MVB} + L_{event}$$

where

L_{exec} = CPU load of executable units (in%)

L_{DS} = CPU load of Data Set communication (in %)

L_{MVB} = CPU load of MVI data block communication (in%)

L_{event} = CPU load of event detection (in%).

CAUTION

Twenty-five percent (25%) of the CPU load must be reserved for basic system functions. The remaining 75% of the CPU load is available for the application program.

3.1.13.7 Example

As an example, the CPU load for PM632 of the application example in Appendix C of *AMPL Configuration Advant Controller 100 Series Reference Manual* is calculated. The calculation of the load for executable unit PC1 is shown in Table 3-12 and for executable unit PC1.1 in Table 3-12.

Table 3-12. Calculation of CPU Load for Executable Unit PC1 for PM632

Function	**Number of Functions N**	**Execution Time T_e (in µs)**	**Cycle Time T_c (in ms)**	**Load L (in%)**
PCPGM	1	690	20	3.45

Table 3-13. Calculation of CPU Load for Executable Unit PC1.1 for PM632

Function	**Number of Functions N**	**Execution Time T_e (in µs)**	**Cycle Time T_c (in ms)**	**Load L (in%)**
CONTRM	1	690	20	
AND	1	7 + 2.5*3		
GET(1)	1	7 + 4 + 4*5		
PUT(2)	1	18 + 4 + 2*5		
		767.5	20	3.84

(1) Four connections to DI610 channel elements (see *DB Elements Advant Controller 100 Series Reference Manual)*
(2) Two connections to DO610 channel elements (see *DB Elements Advant Controller 100 Series Reference Manual)*

The CPU load of the whole application is 3.45+3.84=7.29%.

3.1.13.8 How to Reduce an Excessive CPU-load?

First analyze the application to determine where you can take the most effective optimization action. Primarily, you can take optimization action in five areas, I/O, PC, communication, event detection, Extended DB elements (see *AMPL Configuration Advant Controller 100 Series Reference Manual* for description of Extended DB elements). As usual with optimization, it is most profitable to optimize the part which uses the most CPU-power.

Recommendations for optimization in these four areas are given below.

I/O

- Insert all I/O modules you have configured. Not inserted but configured I/O modules cause additional system load because of error treatment and additional accesses to the missing module.
- I/O signals are scanned with the cycle time of the execution unit (that is, CONTRM) which contains the connections to these I/O signals. If there are I/O signals used which need to be scanned less often than the cycle time of the execution unit in the PC (that is, analogue signals) you can connect those signals in a separate execution unit with a cycle time as low as necessary.
- Select scanning cycle times for the AI channel as big as possible. Of course the accuracy requirement must be considered.

PC

- Check that no execution unit is executed with an unnecessarily short cycle time.
- If possible, break out parts of an execution unit or execution units and allocate to these a longer cycle time.
- Utilize the option to block execution units when they need not be executed. It is also possible to introduce a BLOCK element here when only parts of an execution unit can be blocked.

Communication

- Use as long cycle times as possible for configuring DB elements Data Sets or MVBs.
- For cyclic execution of DB element MVBs do not use terminal EXECUTE to avoid additional PC programming. Configure the MVB for cyclic execution instead.
- If possible use communication modules instead serial link of processor module for certain protocols (that is, RCOM, see Section 3.1.5.1, Provided Link Types).

Event Detection and Extended DB Elements

- Consider that one event detection function with a very small scan time increases the load for all **other** event detection functions drastically.

3.2 Capacity and Performance

This section provides technical data that is relevant from a controller viewpoint. Much of the detailed technical data about hardware modules is given in Appendix A Hardware Modules. This appendix gives a summary of the supported hardware modules. You can find references to technical information either included in Appendix A or separately ordered.

Technical data about communication links is given in separate documentation for the specific link.

The primary structure outlined in Section 1.8, Product Overview is the basis of the presentation. The following subordinated headings are used when relevant:

- General Technical Data, Capacity
  Typical information given is maximum number of instances, magnitudes, distances, and so on.
- Performance
  Typical information is accuracy, CPU load, and so on.

3.2.1 Product Structure

Not applicable.

3.2.2 General System Utilities

3.2.2.1 CPU

General Technical Data, Capacity

Table 3-14. Technical Data of CPU and Memory

Data	PM632	PM633	PM634
CPU type	MC68000	MC68430	MC68430
Clock frequency	16 MHz	25 MHz	25 MHz
static RAM (total)	512 kByte	1 MByte	1 MByte
RAM (for application approx.)	220 kByte	720 kByte	720 kByte

Performance PC and Process I/O

25% of the CPU load must be reserved for base load and reserve. The remaining 75% of the CPU load is available for the application program.

The CPU load of the application determines the performance of an Advant Controller 110. For instructions on how to make calculations, see Section 3.1.13, CPU-Optimization, Load Calculation.

For detailed information on execution times of DB and PC elements, see *Data Base Elements Advant Controller 100 Series Reference Manual* and *PC Elements Advant Controller 100 Series Reference Manual*.

To get an overview to the capacity and performance of the different processor modules Table 3-15 presents execution times and load figures of some application function examples.

Table 3-15. Example of Execution Times and Load for PC Elements

Application Function	**Execution Time**		**Load**	
	PM632	PM633/ PM634	PM632	PM633/ PM634
1000 boolean signals connected via AND or OR elements Complexity: 56 simple logic PC elements (in-line coded AND, OR) each with 19 inputs, cycle time is 200 ms	1.4 ms	0.7 ms	0.7%	0.4%
Several executable units with simple logic PC elements Complexity: 4 CONTRM, each containing 32 x 2 input AND, 64 connections to channels of 2 x DI610, 32 connections to channels of DO610, the cycle times are 100 ms, 200 ms, 300 ms and 400 ms	5.2 ms	2.6 ms	2.7%	1.4%
One measuring circuit, for example, mass flow measuring Complexity: 1 connection to a channel of AI610, 5 arithmetic PC elements (ADD, MIN, MUL, LIM-N, INT) cycle time is 200 ms	0.3 ms	0.15 ms	0.15%	0.08%
Simple feedback control loop Complexity: 1 - PI element, 1 connection to a channel of AI610, 1 connection to a channel of AO610, 5 simple arithmetic PC elements (ADD, MIN, MUL, DIV, LIM-N) cycle time is 200 ms	0.5 ms	0.3 ms	0.25%	0.13%

Performance Event Handling

Table 3-16. Example of Execution Times and Load for Event Handling

Application Function	**Load**	
	PM632	PM633/ PM634
Event detection for 100 digital signals Complexity: 100 DB elements DIC, scan time is 160 ms	38%	19%
Event detection for 100 analogue signals Complexity: 100 DB elements AIC, scan time is 640 ms	39%	20%

Performance Communication - General

Two applications of communication links are dealt with below. Beside RCOM and MODBUS I at serial interface of processor modules PM632/PM633/PM634 the communication link itself will give no rise to controller CPU load. If necessary this load is specified for the application and should be finally added when the individual sending/receiving is considered.

NOTE

> The capacity of the communication link must also be considered in a performance calculation.

See separate documentation attached the used link.

Performance Data Set Peripheral with Advant Fieldbus 100

Data Set Peripherals (DSP) are cyclically transmitted to their respective destinations, with a cycle time selectable in the range 2 ms to 4096 ms.

The CPU load from Data Set Peripheral communication can be estimated from the values given in Table 3-17.

Table 3-17. Example of Execution Times and Load for Data Set Peripheral with Advant Fieldbus 100

Application Function	Execution Time		Load	
	PM632	PM633/ PM634	PM632	PM633/ PM634
10 DSP with 8 DAT the cycle time of DSP and of PCPGM is 32 ms	4.3 ms	2.2 ms	2.7%	1.8%
100 DSP with 8 DAT the cycle time of DSP and of PCPGM is 32 ms	43 ms	22 ms	27%	18%
10 DSP with 4 DAT the cycle time of DSP and of PCPGM is 32 ms	2.9 ms	1.5 ms	19%	10%
10 DSP with 8 DAT the cycle time of DSP and of PCPGM is 16 ms	4.3 ms	2.2 ms	5.4%	2.7%

Performance MODBUS I at Serial Interface of PM632, PM633, or PM634

The following table shows the performance of the local operator station (MMI). In the first column, the MODBUS function code is specified. In the second and third columns, the number of accessed bits or words is listed. Then the performance for 75 percent system load, for 40 percent system load and for a system without any application program are shown in commands per seconds and in effective baud-rate.

Note that the figures are valid for PM632 only; PM633 and PM634 have almost double the performance.

The following table helps the application programmer estimate the performance of the communication link.

Table 3-18. Performance of the MODBUS I Communication Link Using PM632.

Function and Data			75% System Load		40% System load		Without Application	
Func. Code	**Number of Bits**	**Number of Words**	**Command /s**	**Eff. Baud rate**	**Command /s**	**Eff. Baud rate**	**Command /s**	**Eff. Baud rate**
1	8	-	26.3	3682	50.0	7000	55.5	7770
1	64	-	14.2	2982	31.2	6552	33.3	6993
1	256	-	5.6	2520	12.8	5760	15.6	7020
1	1000	-	1.7	2346	4.1	5658	4.8	6624
1	2000	-	0.9	2367	2.1	5523	2.5	6575
3	-	1	26.3	3945	55.5	8325	55.5	8325
3	-	8	16.6	4814	26.3	7627	29.4	8526
3	-	16	10.0	4500	17.2	7740	19.2	8640
3	-	60	4.3	5719	6.1	8113	6.5	8645
3	-	125	2.1	5523	3.1	8153	3.3	8679
5	1	-	26.3	4208	45.4	7264	50.0	8000
6	-	1	26.3	4208	45.4	7264	50.0	8000
15	8	-	22.2	3996	40.0	7200	40.0	7200
15	496	-	2.8	2212	6.7	5293	8.3	6557
15	1968	-	0.7	1841	1.9	4997	2.3	6049
16	-	1	22.7	4313	41.6	7904	41.6	7904
16	-	60	3.6	4932	5.8	7946	6.3	8631
16	-	123	1.9	4997	3.1	8153	3.3	8679

3.2.2.2 Memory

General Technical Data, Capacity

Table 3-19. General Technical Data, Capacity of Memory

Data	PM632	PM633	PM634
Static RAM for system software and application available for application	512 kByte 220 kByte	1024 kByte 720 kByte	1024 kByte 720 kByte
Flash PROM for system software	512 kByte	1024 kByte	1024 kByte
Flash PROM for user built application program	512 kByte	1024 kByte	1024 kByte
Battery backup time	20 weeks	20 weeks	20 weeks

Memory Requirement

Use empirical formulae to permit practical estimation of the memory requirement of the different functions. Refer to Section 3.1.12, Memory Calculation.
For detailed information regarding the memory requirements of different PC elements, see the *PC Elements Advant Controller 100 Series Reference Manual*.

3.2.2.3 System Clock

General Technical Data of System Clock

Inaccuracy expressed as drift in timemax. 0.1 ms/s
(stand-alone system)

When a controller is included in a control network, the clock is synchronized to a master clock, for example, the clock in an operator station or a dedicated controller.
The accuracy is then related to the master clock accuracy.

Relative error in time when synchronized via network max. 15 ms

In case of PM633 and PM634 you can synchronize one or several controllers via external minute pulse signal.
The aim is to synchronize to an accurate external clock and, in the case of several controllers, to keep the relative error in time low.

Relative error in time when synchronized
via external minute pulse signalmax. 0.5 ms

Relative time error with time-tagged events, see Section 3.2.4, Process Interface.

For data of the external synchronization input, see Table 3-20 below.

Table 3-20. PM633/PM634 Clock Synchronization, Electrical Data for Minute Pulse

Data	Value
Input signal (opto coupled input type)	"0" = -50 to + 2 V
	"1" = +12 to + 60 V
Filter time constant	≤1 ms
Pulse length	>10 ms
Triggers at	positive flank

Battery Backup Time	min.20 weeks

3.2.3 Power Supply

Current consumption is a complex matter when it comes to a flexible control system concept. For dimensioning and selection of power supply units, calculation of current consumption, fusing and general guidelines concerning power supply, see Section 3.1.3, Power Supply.

A quick guide of power consumption to use in a very preliminary phase of work on a project or anytime you need estimated figures for planning purposes follows.
Note that average figures are given. That means:

- Average equipped subracks
- Most common mixture of modules.

In other respects, such as technical data, and so on, refer to separate documentation:

Individual power supply units Data sheets included in Appendix A Hardware Modules

Power consumption of I/O modules *S600 I/O Hardware, Reference Manual*.

Table 3-21. Estimated System Power Consumption

Subrack	Power Consumption cos φ >0.7 (at a.c.)
Base station consisting of basic subrack with processor module	30 W
Base station consisting of basic subrack with processor module and extension subrack	50 W
I/O station consisting of basic subrack	20 W
I/O station consisting of basic subrack and extension subrack	40 W

Power Supply Interruption

If power supply is interrupted the operation of the CPU will be affected because there is no buffering time. Mains interruption for min. 10 ms and typ. 12...160 ms are buffered by the power supply unit SA610.

3.2.4 Process Interface

General Technical Data, Capacity

Event Handling

Independent from type of event for each event set element (DB element EVS) there is a queue in the controller. You can create up to 32 EVS elements and thus have up to 32 event queues. These queues store an event burst. Each queue has the following capacity:

Table 3-22. Size of Event Queue for Event Burst

Type of queue	Buffer size
NORMAL	100 events
EXTENDED	1000 events

If an event burst exceeds the capacity of a queue, the overflow is indicated at the EVS element. For more information see *AMPL Configuration Advant Controller 100 Series Reference Manual*.

The loss of events is also reported to the operator station, AdvaSoft for Windows, by an event with time marked "uncertain".

Relative time error with time-tagged events:

• Event detection executed by DI650/ DI651/ DI651	1 ms
• Event detection executed with AIC/DIC/Extended DB elements (Time error depends on scanning selected at event channel elements AIC, DIC.)	3 x SCANT

For system clock accuracy, see Section 3.2.2.3, System Clock.

3.2.4.1 S600 I/O

General Technical Data, Capacity

Note that you must consider practical limits when the data below is applied, for example:

- Space in the used cabinet
- CPU load
- Integrity aspects
- Availability aspects.

Table 3-23. Capacity S600 I/O

Data	Value
No. of busses (bus extension)	1
No. of base station	max. 1
No. of I/O station	max. 7
No. of extension subrack per station	max. 1
Total length of bus extension cable	max. 20m
No. of I/O modules per subrack	max. 20
No. of I/O modules per controller	max. 151
No. of digital input channels	max. 4812
No. of digital output channels	max. 4812
No. of analogue input channels	max. 4812
No. of analogue output channels	max. 2416
No. of submodule carrier SC610	max. 1
No. of communication interface module for Advant Fieldbus 100 CI626	max. 2
No. of communication interface module for MasterFieldbus, slave function CI670	max. 4
No. of communication interface module for MasterFieldbus, master function CI671	max. 4
No. of other module types CI532	max. 2

3.2.5 Communication

3.2.5.1 Provided Link Types

General Technical Data, Capacity

Table 3-24. Link Types (Hardware and Software)

Link Type	Number of Instances	
Advant Fieldbus 100	max. 2 buses	
MasterFieldbus (slave function)	max. 4 buses	
MasterFieldbus (master function)	max. 4 buses	
Bus extension to S600 I/O	max. 1 bus	
PROFIBUS-DP	max. 1 bus	
RCOM via second serial interface at processor module	max. 1 link(1)	Total max. 1
MODBUS (slave function) via second serial interface at processor module	max. 1link(2)	
RCOM via submodule CI532	max. 4 links(1)	Total max. 4
MODBUS via submodule CI532	max. 4 link(2)	
SIEMENS 3964R via submodule CI532	max. 4 links	

(1) You can install RCOM in various ways. That means when using communication interface modules CI532 and serial interface at processor module you can install up to max. 5 links for RCOM.

(2) You can install MODBUS in various ways. That means when using communication interface modules CI532 and serial interface at processor module you can install up to max. 5 links for MODBUS.

3.2.5.2 Applied Communication

General Technical Data, Capacity

Normally there are no limits in capacity beyond the limits placed by the actual link for the application. Extended information for certain applications are found below. Regarding the maximum number of links available in Advant Controller 110, you can find information in Section 3.2.5.1, Provided Link Types above. For further technical data such as load data, performance, maximum lengths, and so on, for the different links, see separate documentation.

Data Set Peripheral (DSP) with Advant Fieldbus 100

A Data Set Peripheral can hold 1 to 8 DAT values. Each DAT value represents 32 Boolean, or 1 integer (16 or 32 bit), or 1 real number.
Advant Controller 110 can accommodate max. 200 data set peripheral for each of max. two communication on Advant Fieldbus 100 links.
Data Set Peripherals are cyclically transmitted to their respective destinations, with a cycle time selectable in the range 2 ms to 4096 ms.

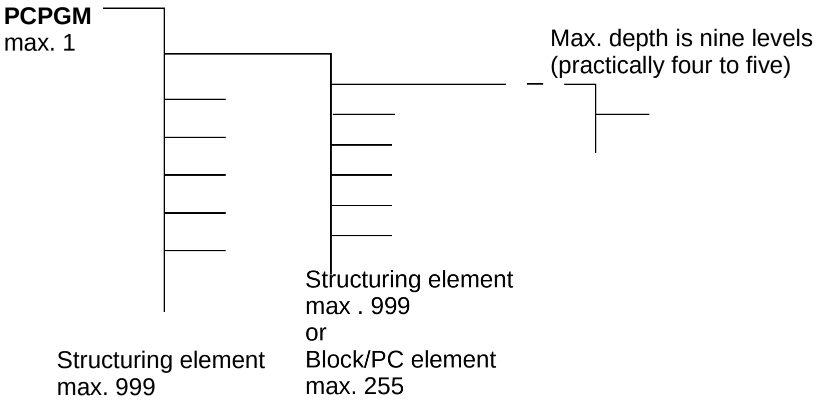
3.2.6 Process Control

General Technical Data, Capacity

Primarily, an application program for process control is "softly" limited by different considerations like: CPU load, integrity, availability, security, and so on. You can find information on these topics in part elsewhere in this manual. Some key data put "hard" limits on an application program for process control. The main key data are listed below.

Table 3-25. Key Data, Process Control

Key Data	Maximum Number
No. of I/O channels (corresponds to no. of signals)	See Section 3.2.4, Process Interface
No. of PC programs, PCPGM	1
Levels in structure	9 (practical limit is 4-5)
No. of control modules for structuring and execution control	See Figure 3-23, Structuring Limits
Structuring/execution elements: CONTRM, SEQ, MASTER	total 31
Structuring/function element: FUNCM, STEP, SLAVE	total 999 per level in structure
BLOCK	total 255 per level in structure
PC element	
Data transfer and Communication: DAT	5461



Note: Structuring/execution element CONTRM, SEQ, MASTER
Structuring/function element FUNCM, STEP, SLAVE, BLOCK

Figure 3-23. Structuring Limits

3.2.7 Operator's Interface

3.2.7.1 Local Operator Station

General Technical Data, Capacity

The number of local operator stations which are communicating via serial interface at processor module using MODBUS protocol to is limited to 1.

3.2.7.2 Central Operator Station

General Technical Data, Capacity

The number of operator stations of the type AdvaSoft for Windows communicating with one Advant Controller 110 is limited to 10.

3.2.8 Availability

The reliability and availability of an Advant Controller 110 and its I/O can be calculated on request. Such a calculation can be adapted to the actual application and it can be extended to include all ABB Master equipment in an automation system.

3.2.9 Mechanics

General Technical Data

Cabinet Dimensions.

Table 3-26. RM500 Cabinet Measurements

Characteristics	Cabinet Type		
	RM500V1 Height = 1925 mm (75.8 inch.)	**RM500V1 Height = 2125 mm (83.7 inch.)**	**RM500V2 Height = 2225 mm (87.6 inch)**
Dimensions			
Cabinet(1) WxDxH	800x512x1925 mm (31.5x20.2x75.8 inch.)	800x512x2125 mm (31.5x20.2x83.7 inch.)	700x637x2225 mm (27.6x25.1x87.6 inch.)
End Panel(2) W1xD1	20x530 mm (0.8x20.9 inch.)	20x530 mm (0.8x20.9 inch.)	20x655 mm (0.8x25.8 inch.)
Cable Entry W2xD2	660x311 mm (26.0x12.2 inch.)	660x311 mm (26.0x12.2 inch.)	560x436 mm (22.0x17.2 inch.)
Weight(3)	150-200 kg (330-440 lbs)	150-200 kg (330-440 lbs)	150-200 kg (330-440 lbs)

Table 3-26. RM500 Cabinet Measurements

Characteristics	**Cabinet Type**		
	RM500V1 Height = 1925 mm (75.8 inch.)	**RM500V1 Height = 2125 mm (83.7 inch.)**	**RM500V2 Height = 2225 mm (87.6 inch)**
Doors	Single/Double	Single/Double	Single
Mounting Planes	19"/24"	19"/24"	19"
U-Modules(4) Cabinet/Hinged Frame	39U/37U	43U/41U	45U/43U
Swing Radius(5)			
Single Door (SD)	793 mm (31.2 inch.)	793 mm (31.2 inch)	693 mm (27.3 inch.)
Double Door (DD)	415 mm (16.3 inch.)	415 mm (16.3 inch.)	-
Subrack (S100 I/O) in Hinged Frame (SR)	600 mm (23.6 inch.)	600 mm (23.6 inch.)	600 mm (23.6 inch.)

(1) The dimensions includes door and rear plate.
(2) W1xD1 shows the dimension for a single end panel. When mounting two end panels to a cabinet add 2x20 mm at the cabinet width, W but use D1 as cabinet depth.
(3) The weight does not include equipment to be installed within the cabinet.
(4) U-Modules, see Appendix E, Item Designations.
(5) The space required for door(s) and the hinged frame. See Figure D-3.

Protection Rating

Cabinets are available for different environmental protection classes.

Table 3-27. RM500 Cabinet Protection Classes

Type	**Protection class**
	RM500
Ventilated, **not** radio-proof (1) (2)	IP 21
Ventilated, radio-proof (2)	IP 21
Ventilated (3)	IP 41
Sealed	IP 54
Sealed with heat exchanger (4)	IP 54

(1) Advant Controller 450 with S100 I/O, installed in this cabinet is **not** verified for CE-marking.
(2) Standard cabinet without filter on ventilation grilles.
(3) Ventilation grilles are covered with metallic net to prevent insects to enter the cabinet. A heater is included to heat the cabinet when the controller is not in use.
(4) Available as a standard sealed cabinet with heat exchanger as an option.

Table 3-28. Available Degree of Protection Ratings for RM500

	RM500V1 H=1925 mm (75.8 inch.)			RM500V1 H=2125 mm (83.7 inch)			RM500V2 H=2225 mm (87.6 inch.)		
	IP21	**IP41**(1)	**IP54**	**IP21**	**IP41**(1)	**IP54**	**IP21**	**IP41**(1)	**IP54**
Cabinet with or without hinged frame	X	X	X	X	X	X	X	X	X
Cabinet for OOCU	X	X	X	X	X	X			
Cabinet, NOT verified for CE marking	X			X			X		

(1) IP41 includes a heating element, and the ventilation grilles are covered with nets.

Electro Magnetic Compatibility, EMC - RM500

RM500 cabinet versions fulfil the demands in accordance with article 10.1 and 10.3 of the EMC (Electro Magnetic Compatibility) directive 89/336/EEC.

CE-marked Equipment

CE-marking of Avant Controller 110 implies some measures with respect to cabinets, mains supply filtering and handling of cable shields at the enclosure. All to ensure conformity to the EMC-Directive 89/336/EEC. Refer to Chapter 2, Installation for more information.

According to information given in the ordering documentation, equipment shall be located in metallic or radio-proof cabinets (depending of product).

Open compartment is not permitted. Immunity against electromagnetic fields can generally be guaranteed with the cabinet containing metallic doors only.

Subrack Dimensions

The controller components are installed in a subrack in which you insert the S600 I/O modules too. Refer to Section 2.2.14.2, Assembly for a description of different kinds of subracks.

Table 3-29. Controller Subrack Dimensions

Data	Value
Width	19 inches (482 mm)
Depth	325 mm
Height	269 mm(1)

(1) The cable duct RC610 adds a further 100 mm to the height. In order to insert and withdraw I/O modules, a minimum space of 120 mm above the subrack is required. You should also leave a space of 120 mm below the subrack for ventilation purposes.

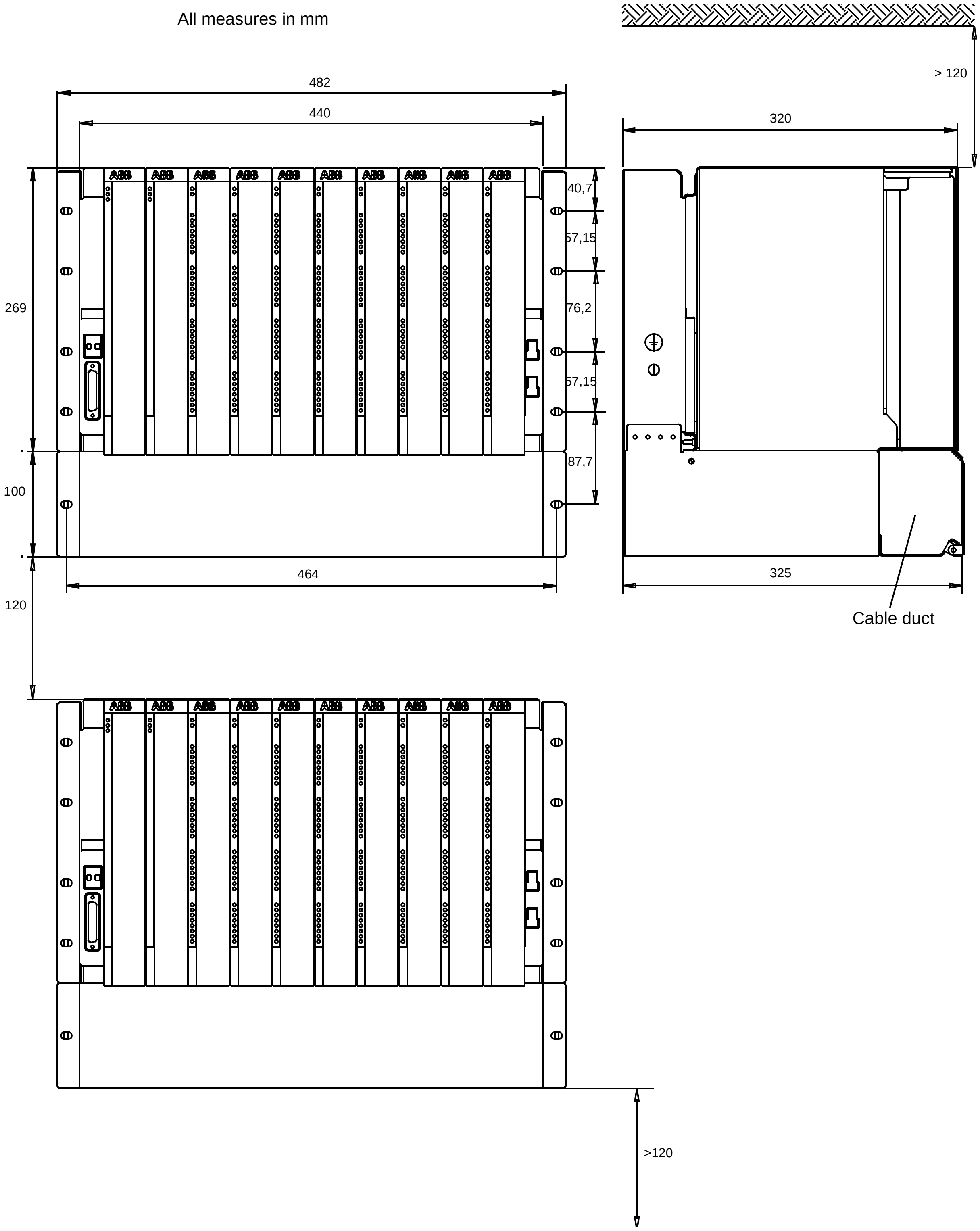


Figure 3-24. Controller Subrack and Cable Duct, Dimensions

Position disposition for subracks

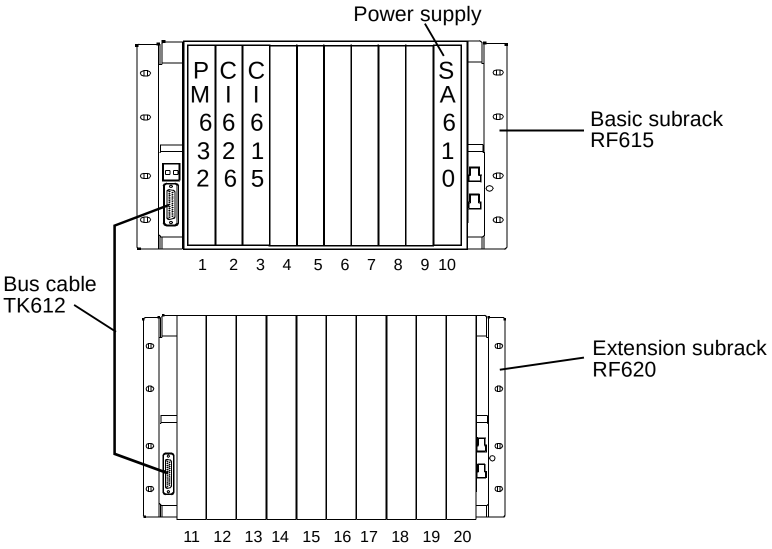


Figure 3-25. Controller Subrack, Position Disposition

Table 3-30. Position Disposition for Basic Subrack in Base Station

Position	Module
1	PM632, PM633, PM634
2 - 9	Any other S600 I/O module except CI610
10	SA610 or any S600 I/O module except CI610

Table 3-31. Position Disposition for Extension Subrack in Base Station

Position	Module
11 - 19	Any S600 I/O module except CI610
20	SA610 or any S600 I/O module except CI610

Table 3-32. Position Disposition for Basic Subrack in I/O Station

Position	Module
1	CI610
2 - 9	Any S600 I/O module except CI610, CI615, CI626, CI627
10	SA610 or any S600 I/O module except CI610, CI615, CI626, CI627

Table 3-33. Position Disposition for Extension Subrack in I/O Station

Position	Module
11 - 19	Any S600 I/O module except CI610, CI615, CI626, CI627
20	SA610 or any S600 I/O module except CI610, CI615, CI626, CI627

3.3 Database Configuration

For information on configuration and application building for Advant Controller 110, refer to following documents.

- Instructions for the configuration and application programming of Advant Controller 110 systems - *AMPL Configuration Advant Controller 100 Series Reference Manual*
- Data for all PC elements in Advant Controller 110 - *PC Elements Advant Controller 100 Series Reference Manual*
- Data for all Data Base elements in Advant Controller 110 - *Data Base Elements Advant Controller 100 Series Reference Manual*
- Basic manual covering the use of the application program language AMPL - *AMPL Application Building Reference Manual.*

3.4 Tutorial

The aim of this section is to give those who are inexperienced in this area a **short guide** through the different phases of a controller design project. There are methods and tools developed to make such project work effective in a variety of aspects. No references are made to methods and tools in this section because that is beyond the scope of this product manual.

Whenever possible, concrete references are made to suitable sections in this manual or to other documentation. The novice reader will preferably read Chapter 1, Introduction and Section 3.1, Considerations in this manual completely before starting the design work.

3.4.1 Introduction to the Design

The realization of a control system is normally based on a range of different documents.
On the highest level, there are Plant Descriptions giving basic and general requirements like:

- Function
- Operation
- Security
- Availability
- Maintenance.

Individual requirements on particular supporting processes like electric, instrument air, cooling, and so on, and particular subplants and sections are given in the Plant Design Documents. Here you can also find documents which are the basis of the control system design.
Examples of such documents commonly used are:

- Function Descriptions (detailed)
- R&I diagram
- Instrument lists
- Motor lists
- I/O lists
- Applicable standards (plant, domestic, international).

3.4.2 Design Procedures

The following four main stages can be identified in the control system design procedure:

- System Definition
  Based on process control application analyses, a definition of the equipment must be made.
  The system definition phase is supported by this manual, especially Chapter 1, Introduction, which gives an overall introduction from the functional and available resources viewpoints and, of course, Section 3.1, Considerations. In addition, Section 3.2, Capacity and Performance gives some important information.
  The *ABB Master Product Guide* gives you an overview of the available product alternatives and possible options. Not "every combination" is either practical or offered.
- Configuration/Application Building
  This phase is, to a certain extent, supported by the same chapters as the system definition phase. However, most information is available in separate reference documents as follows:
  AMPL Configuration Advant Controller 100 Series Reference Manual,
  PC Elements Advant Controller 100 Series Reference Manual,
  Data Base Elements Advant Controller 100 Series Reference Manual
  Refer to Section 1.5, Related Documentation for further document information.
- Installation
  This is not really a design procedure. However, during the design there are certain installation considerations to take care of, for example, the connection to the process. It is mentioned here as a reminder.

3.4.2.1 System Definition

System definition in the actual context is a definition of the equipment required.
As a basis of the system definition, it is assumed that superior design stages have resulted in an overall rough application-functional identification. It is further assumed that a scheme of the functional distribution is available. Thus, a rough allocation of functions to different controllers is available.

Main points in the definition of a particular controller are:

- Type of controller to be used, reflecting
  - Security questions such as hazardous applications, emergency situations, abnormal operating situations, consequences in the event of a failure, behavior at start/stop, behavior at maintenance, manual control.
  - CPU performance
  - Capacity requirements
  - Dependability questions like availability, integrity
  - Need for communication (need for physical interface).
- Type of I/O system
  Centralized or distributed location of I/O is normally determined at prior and superior design stages reflecting such questions as maintenance, environment, economy (cable savings).
- I/O module assortment. Limitation in number of different types is often desirable.

- Physical interface to the process. Terminal blocks, marshalling, hazardous applications.
- Application of redundancy.
- Environmental questions. Special requirement of cabinets.
- Mechanical design. Cabinet lay-out.

3.4.2.2 Configuration/Application Building

The next step is to make a detailed function identification and to design the application program based on AMPL. Finally, you implement the program.

To sum up, the main activities are:

- Circuit identification with respect to
  - Standard type circuits
  - User-defined type circuits.
- Structuring
- Definition of functional interface to other system
- Execution control work-through
- Configuration/Implementation
  This is mostly an interactive session using an engineering station.

Some of these activities, subactivities and other similar subjects of interest are dealt with below.

Naming

All global objects are identified (and accessed) by unique names which you define within an application project. Certain objects are given default names by the system, which you can change later. From the system's point of view, the name structure is flat. However, since a name is a visible ASCII string, you can implement any kind of structure in naming objects.

Names are introduced in a controller via data base elements representing the actual object. In general, the designation (connection NAME) on the data base element must be unique in the controller. Designations referred to from an operator station (for example, AdvaSoft for Window) via a Control Network must also be unique in the total process control system connected to that network.

When defining signals, it is important that the signals be given names which are well considered and will not have to be changed at some later stage.

With auto-generation of a PC-diagram, the signal names are printed in the diagram. This is the reason for providing the signals with plain language names, even with a stand-alone controller.

The philosophy behind the naming of the signals is to also be applicable to calculated signals (for example, DB elements AIC and DIC). As an example, the signal provided by a level transmitter is named LT 104.

The designation philosophy for objects in the process control system must be established when the signals are named. (Following relevant standards.) The designations should preferably be hierarchic so that objects and signals are given associative names.

A feedback control loop for level control is an example (see Figure 3-26).
The actual value (the feedback signal) is suitably designated LT 104 (LT = Level Transmitter) and the controller output value LV 104 (LV = Level Valve). These names are obtained from one of the standards for designations in process industries, ISO 3511.

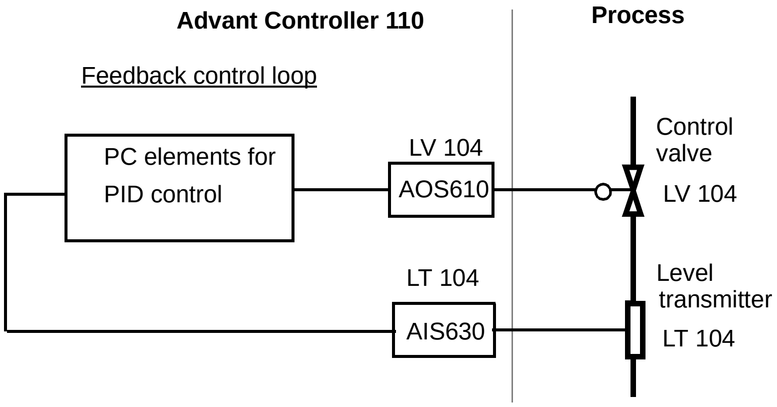


Figure 3-26. Example of Designations in Feedback Control Loop

Type Circuits

Type circuit building is a very important aid in the configuration procedure. A type circuit is the largest common collection of PC elements which occurs at several places in the application program.

A type circuit can be, for example, a certain type of feedback control loop or a panel control unit with push buttons and lamps. An advantage obtained by working with type circuits is that the work in designing the application program is reduced.

Instead of designing X program parts, one part is designed and used X times at different places, perhaps with the addition of a minor PC element for adaptation in certain cases.

When the function of a type circuit is thoroughly verified in one application, the commissioning of the remainder is much simpler. Another advantage is that the operator's functions based on type circuits become standardized.

Application Building with AMPL

This phase is carefully supported by separate documentation as mentioned earlier. Some general notes and rules regarding application building and structuring are also given in Section 3.1.6.4, Guidelines for Application Building, where the subject is dealt with from other vantage points.

Configuration/Implementation

This phase mainly comprises the interactive work carried out with the help of an engineering station, for example, Advant Station 100 connected to the target system. It is supported by separate documentation as well, mostly the reference manual, *AMPL Configuration Advant Controller 100 Series Reference Manual*.

Chapter 4 Runtime Operation

4.1 Operating Overview

An Advant Controller 110 is an autonomous station which normally is not handled by an operator. Of course, it is started and sometimes stopped manually. This is done, however, in specific situations such as at the time of installation work and maintenance. Accordingly, operating instructions are spread out in this manual. See where the specific activity is treated. For general descriptions, see the following sections of this chapter. For concrete instructions, see Chapter 2, Installation and Chapter 5, Maintenance.

4.2 Operating Instructions

See the reference made in Section 4.1, Operating Overview.

4.3 Product Operation

4.3.1 Working Modes

Advant Controller 110 has two working modes:
OPERATION/DEBLOCKED and OPERATION/BLOCKED.

The diagnostic indicator (LED display) on the processor module front indicates the working mode with the codes
P1 and P3, respectively.

P1, working mode OPERATION/DEBLOCKED:

> The processor module executes the application program. This is the normal status of an Advant Controller. The system can then perform control modules and control the process outputs.

P3, working mode OPERATION/BLOCKED:

> The processor module does not execute the application program (application is blocked). The process outputs remain their states.

During the boot phase and during the time of transition between working modes the display will indicate intermediate **system states.** These codes are relevant at fault finding and system analyses. These codes beside error codes are described below. See chapter 5 for the description of error codes.

4.3.2 Ordering Working Modes

You order working modes in either of the following ways:

- Use a start mode.
- Use Advant Station 100 Series Engineering Station commands.

4.3.3 Start Modes

In general, you can start an Advant Controller 110 in three different ways, as selected with the selector START MODE on the processor module front.

The START MODE selector has 3 positions for processor module PM632 and 4 positions for processor module PM633and PM634. These are named STOP, CLEAR, AUTO, and DIAG. Position DIAG is only available at PM633 and PM634.

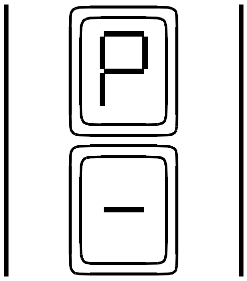
At first you select the start mode with the START MODE selector and then press the INIT button at the processor module. The system will restart according to the chosen start mode.

Table 4-1. Positions of START MODE Selector

Position	Function
STOP	The processor module does not start to execute the user application after pressing the INIT button or after power up. User defined PC elements (Add-on options) are not installed in this mode.
CLEAR	The processor module executes a cold start of the user application program after pressing the INIT button or after power up. All variables are initialized.
AUTO	The processor module executes a warm start of the user application program after power up. All variables are kept, as long as the RAM is correctly buffered.
DIAG	The processor module does not start to execute the user application after pressing the INIT button or after power up. The system software executes only the initial system diagnostics. User defined PC elements (Add-on options) are not installed.

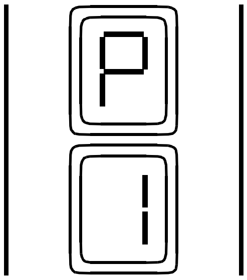
4.3.4 Relation Between Start Modes and Working Modes

Using the START MODE selector you can influence the working mode and (intermediate) system states of an Advant Controller 110 which are described below. These working modes and system states are indicated on the diagnostic display of the processor module which is comprised in an upper part and lower part in the following way:



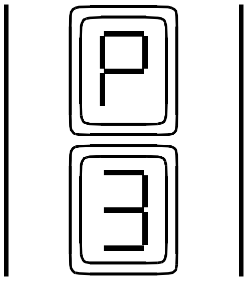
The processor module is in its initial phase.

(Display P- is independent from position of **START MODE** selector)



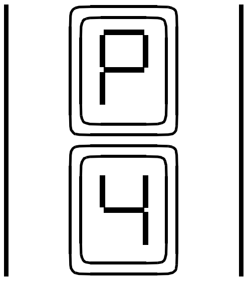
The controller is in working mode OPERATION/DEBLOCKED.

START MODE selector on position **CLEAR or AUTO**



The controller is in working mode OPERATION/BLOCKED.

The controller was blocked by engineering station **or** by **START MODE** selector in **STOP** position after initialization.

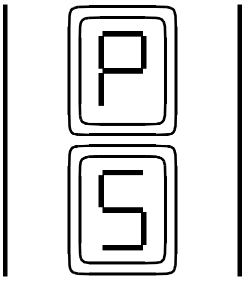


The processor module is not running an application program.

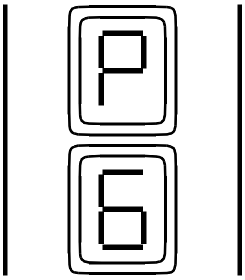
The controller is in working mode OPERATION.

START MODE selector on position **CLEAR or AUTO.**

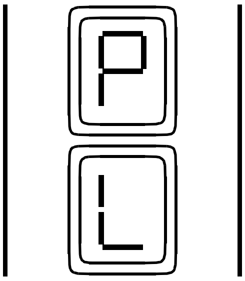
Figure 4-1. Examples of Diagnostic Display (Part 1)



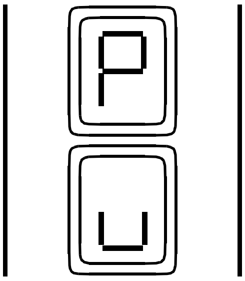
The processor module is loading an application program from the internal PROM.
START MODE selector on position **CLEAR or AUTO.**



The engineering station is connected and is in the on-line mode.
(Display P6 is independent from position of **START MODE** selector)



Waiting for download of system software.
(Display PL is independent from position of **START MODE** selector)



Loading of system software option is in progress.
(Display PU is independent from position of **START MODE** selector)

Figure 4-2. Examples of Diagnostic Display (Part 2)

4.3.5 Relation Between Engineering Station Commands and Working Modes

The following engineering station commands order working mode transitions:

- Function Chart Builder Command **Target | Block Program**

  Orders the controller from working mode OPERATION/DEBLOCKED to working mode OPERATION/BLOCKED.

- Function Chart Builder Command **Target | Deblock Program**

  Orders the controller from working mode OPERATION/BLOCKED to working mode OPERATION/DEBLOCKED.

- Function Chart Builder Command **Target | Restart**

  To execute Function Chart Builder Command **Target | Restart** the controller must be ordered into working mode OPERATION/BLOCKED before.

  Function Chart Builder Command **Target | Restart** orders the controller from working mode OPERATION/BLOCKED to system state Cold Start.

  If the START MODE selector was in AUTO or CLEAR position the controller will then be ordered to working mode OPERATION/DEBLOCKED.

  If the START MODE selector was in STOP position the controller will then be ordered to working mode OPERATION/BLOCKED and no application program will be loaded from internal flash PROM of the processor module.

4.3.6 System States

4.3.6.1 List of System States

The following table lists all the system states of the controller. They are indicated by the diagnostic display at the processor module. The working modes OPERATION/DEBLOCKED and OPERATION/BLOCKED corresponds to the system state OPERATION.

Table 4-2. System States of Advant Controller 110

System State	Description	Diagnostic Display
Power Off	The Advant Controller 110 has no power.	off
Booting	After power on, Advant Controller 110 starts with execution of the boot program. Then basic initialization starts. It decides according to START MODE selector	off
Cold Start	The processor module hardware and RAM is initialized (except a few variables which have to be preserved), the operating system is started and the tasks are created.	P-
Warm Start	The controller recovers from a power failure. This means that the processor module hardware is initialized, the I/O modules are configured. The RAM content is preserved by battery or capacitor buffering. The controller proceeds working where it was interrupted.	P=
OPERATION	The controller is operational. If an application program was loaded it can be deblocked (working mode OPERATION/DEBLOCKED) or blocked (working mode OPERATION/BLOCKED).	P1, P3, P4, P5, P6

Table 4-2. System States of Advant Controller 110 (Continued)

System State	Description	Diagnostic Display
Halt	The controller is shut down. The process outputs are switched off. The coil of the run/alarm relay of the processor module is deactivated. Then, a minimum cold start is executed which only provides the communication to the engineering tool via serial interface at processor module or remote via AF100 or RCOM (if configured).The diagnostic display of the processor module shows the error code. User defined PC elements (Add-on options) are not installed in this mode (because it could be the error reason). To recover from this state you can take **one** of the following measures: • Press the INIT button at the processor module • Switch off and on power • Execute Function Chart Builder command **Target | Restart** at the engineering station. This is also possible via RCOM or AF110 (remote connection).	error code
Stop	The controller is shut down. The process outputs are switched off. The coil of the run/alarm relay of the processor module is deactivated. The diagnostic display of the processor module shows the error code. The red fault LED at the processor module is switched on. To recover from this state you can take **one** of the following measures: • Press the INIT button at the processor module. • Switch off and on power.	error code
Power down	Power off leads to a power down interrupt in the processor module. The corresponding interrupt service routine prepares the processor module for warm start.	4A, then off
Loading system software or options	New system software (BASE) or options (OPT) are being loaded.	--, PL, PU, then continue

4.3.7 System Software

This section contains just a brief description of the internal Advant Controller 110 software. For more information refer to *AMPL Configuration Advant Controller 100 Series Reference Manual*.

4.3.7.1 Structure

The system software provides internal program functions and links together the application program with the system hardware.

Figure 4-3 presents broadly the main parts of the Advant Controller 110 software.

The application programs are built up and edited with an engineering station using the Function Chart Editor.

The execution of the executable units in the PC program is organized by the Kernel of the Advant Controller 110 system software which also handles certain program amendments, primarily those performed during execution (on-line configuration and programming, value display and forcing, see Section 1.8.6.2, On-line Features.

Kernel

The PC program and the related control modules (the executable units) in an AC 110 must coexist with other types of programs such as diagnostic and communication programs. One task of the kernel is to schedule the execution of the different executable units.

The kernel schedules, at each point in time, the execution of the program with the highest priority. This may have the effect that the execution of an execution unit is interrupted temporarily by another executable unit. This, however, has no effect on the function of the PC program.

Communication

The communication part of the AC 110 system software supports the communication with the tools (engineering station), other controllers (for example, AC 55) or operator stations (for example, AdvaSoft).

Diagnostics

The diagnostics program performs diagnosis of the processor module and all connected modules. The diagnostics program writes error information into an error buffer. The error buffer can be read and deleted by means of an engineering station.

Function Block Library

The function block library contains the execution code of PC elements and internal function blocks (for example, functions for display and force of values, move blocks between data areas).

The software of the AC 110 systems is schematically illustrated below.

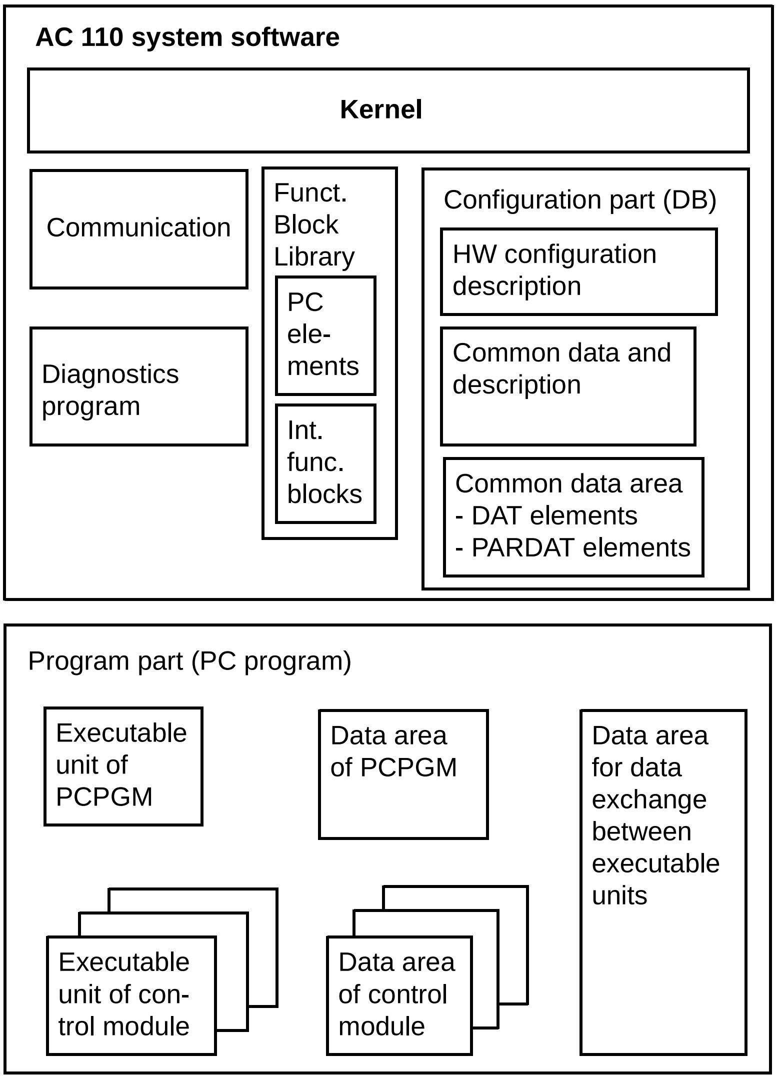


Figure 4-3. Block Diagram of AC 110 Software

4.3.7.2 Process Communication

AC 110 exchanges data with the process. This is performed directly via backplane-connected S600 I/O modules, S600 I/O modules in I/O stations or via remote S800 I/O modules communicating through AF100.

Data for these I/O modules are stored in the following different data areas:

- Hardware configuration description area containing configuration data for the I/O modules and channels
- Local data areas of PCPGM and of control modules containing process data.

Data transfer of configuration data to the I/O is performed during system initialization and for on-line exchanges after the download of new configuration data.

Data exchange between the process and the local data areas is performed directly by the related executable units within their input and output phases.

Input and Output Phases

To isolate each execution unit from data change during execution, the execution is commenced by an input phase and ends with an output phase.

This data exchange is performed by GET elements for the input phase and PUT elements for the output phase.

The PUT and GET elements are internal function blocks of AC 110.

PUT and GET elements are automatically inserted by the engineering stations.
They are indicated in the PC diagram by a ‘P’ or a ‘G’. Figure 3-15 shows you an example of the layout of a PC program with ‘P’ and ‘G’ indications.

Input

During the input phase of an executable unit, the used values are stored in the local data area of the executable unit. Sources of these data are the following:

- I/O and communication modules and channels
- Common data area
- Data area for data exchange between executable units.

Output

During the output phase, the calculated data from the PC elements in an execution unit are transferred to the following sinks:

- I/O and communication modules and channels
- Common data area
- Data area for data exchange between executable units.

The data is fetched directly from the storage location of each PC element output.

4.3.8 Application Program

The application program is written in a high-level language AMPL. A user normally only comes in contact with AMPL and the specification of data base elements (DB elements).

The application program consists of a PC part and a DB part.

This section contains just a brief description of the application program for Advant Controller 110. For more information refer to *AMPL Configuration Advant Controller 100 Series Reference Manual.*

4.3.8.1 DB Part

The DB part in an Advant Controller 110 contain the DB elements which are used to configure the Advant Controller 110.

DB elements in an Advant Controller 110 system describe the following items:

- The hardware of the Advant Controller 110 system (for example, processor module, I/O modules, and so on)
- Communication interfaces (for example, MVICHAN, connection to AF 100, and so on)
- Common data elements (for example, DAT, PARDAT)
- Event handling
- Connection between the hardware and the common data elements (Data Set Peripheral DSP)
- Extended DB elements covering a set of the previous items and MMI functions AIS, DIS, AOS, DOS, MB, MBS, MI, MIL, and MR.

See *Data Base Elements Advant Controller 100 Series Reference Manual* for detailed description of each DB element.

4.3.8.2 PC Part

The PC part of a user application program describes the control algorithm and the control strategy. It contains the required PC elements, their interconnections, and the connections to the DB elements.

A PC program can be divided into several execution units, which consist of PC elements. Each execution unit can be given its own cycle time and its own execution conditions.

Figure 3-15 shows you an example of the layout of a PC program.

PC elements are the smallest "building blocks" in a PC program. They are described in detail in *PC Elements Advant Controller 100 Series Reference Manual*.

4.3.8.3 Execution

Sequence of Execution of Execution Units

In certain applications, the order in which execution units are executed is of interest. Assume that a function is divided into execution units which exchange data with each other and that these units have the same cycle time, see Figure 4-4.
It is also assumed that execution unit 1 is required to execute before unit 2.

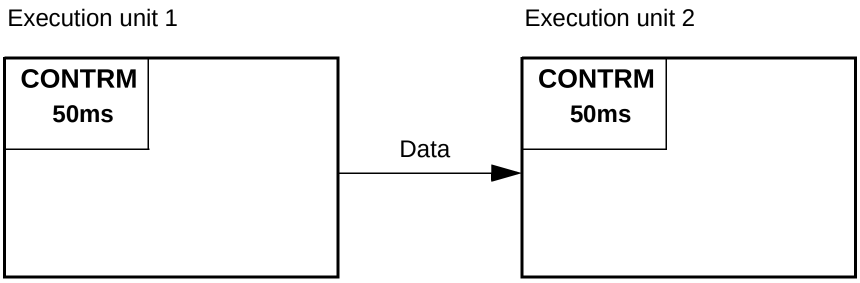


Figure 4-4. Function Consisting of Two Execution Units

When the conditions for an execution unit are defined, it is possible, with the call parameter "Place in the cycle table" of CONTRM, to specify a place number between 1 and 255.
This place number specifies the order in which the execution units are executed during the same cycle time. If, in the example, the place number 1 is specified for the execution unit 1 and the place number 2 is specified for unit 2, the required function is obtained.

The different execution units may well belong to different PC programs, but they must all have the same cycle time. For units with different cycle times, there is no defined sequence.
A required start sequence can, however, be obtained by controlling the start conditions for the execution units included.

Execution Sequence within an Execution Unit

AC 110 processes the different execution units in a certain order. The following examples shows the order for a PC program PCPGM and the executable unit CONTRM (for description of other executable units refer to *AMPL Configuration Advant Controller 100 Series Reference Manual*):

- Processing of PC program (processing of PCPGM)

    1. Reading input values of the structure element PCPGM
    2. Processing structure element PCPGM
    3. Writing output values of the structure element PCPGM
    4. Transfer of common data between common data area and Advant Fieldbus 100 Data Set communication

- Processing of control module CONTRM

    1. Reading input values of the structure element CONTRM
    2. Processing structure element CONTRM
    3. Writing output values of the structure element CONTRM
    4. Reading input values in the control module
    5. Processing elements in the control module
    6. Writing output values in the control module.

4.3.8.4 Execution Sequence of PC Elements

After the execution of the function of a particular execution unit and after the reading-in phase for the control module (see section above describing CONTRM), the execution of the PC elements included begins. This is performed, element by element, in the order in which they are entered at program entry, which also corresponds to the order of documentation.

In the following example the elements are executed in accordance with the broken arrows.
See Figure 4-5.

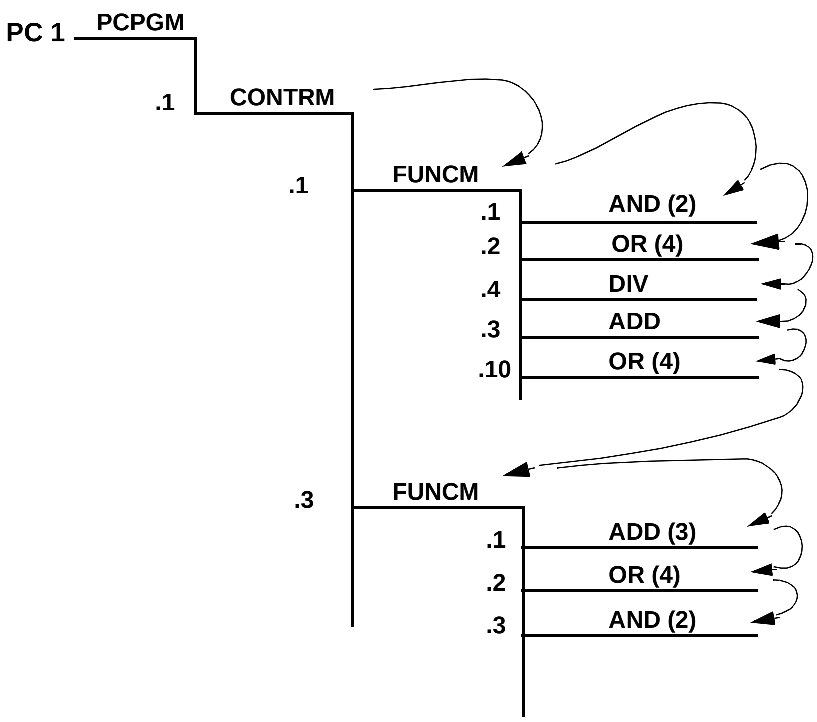


Figure 4-5. Tree View of PC Program, Execution Order of PC Elements

Note that the item designations of the individual PC elements have no effect on the order of execution. The PC element DIV with item designation PC1.1.1.4 is thus executed before the PC element ADD, PC1.1.1.3.

4.3.8.5 Execution Sequence for an Individual PC Element

Execution of the PC elements commences after the execution of the header of an execution unit and the execution of the input elements.

The PC element itself controls its execution by calling the code in the element library for the next element. This is done in the order of storage, which also corresponds to the entry and documentation order.

The program code in the library works with a part of the PC program corresponding to a single element.

The execution sequence within a PC element is illustrated in Figure 4-6 by an ADD-gate with two inputs.

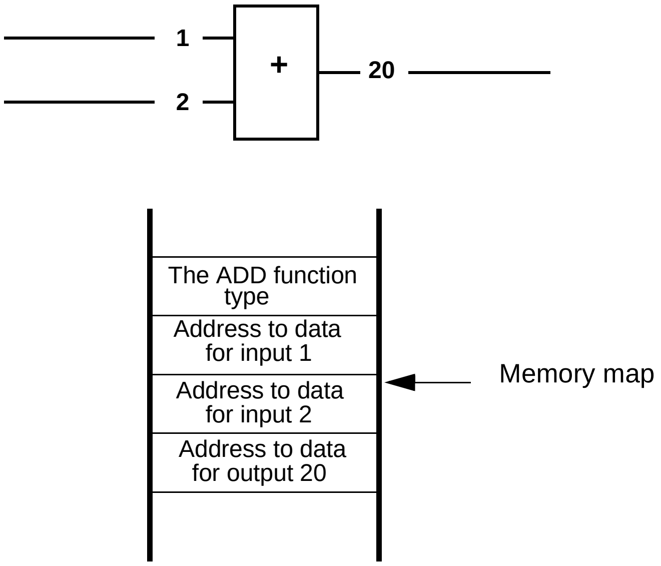

1
2
+
20
The ADD function type
Address to data for input 1
Address to data for input 2
Address to data for output 20
Memory map

Figure 4-6. Execution Order of PC Element, ADD with Two Inputs

The order of execution is:

1. Previous PC element reads function type, in this case ADD, and calls the program code for this function from the element library.
2. Current values at the storage places pointed out by inputs 1 and 2 are read from local data area of the executable unit. The arithmetic ADD-function is executed according to the program code ADD.
3. The result is stored at the storage place specified for output 20 in the local data area of the executable unit.
4. Then the current ADD program code reads the function type of the next element and calls the related element code to proceed with the next element in the PC program.

PC elements coded with in-line code are an exception. These elements are coded directly as processor instructions.

4.3.8.6 Reset Execution

Clearing or reset execution takes place when an R input of a module header is active. This has the effect of setting all variables in the local data area of the module to an initial value. For most variables, this implies that they are set to the zero value of their respective data type.
(There are, however, certain exceptions to this, since the outputs of a certain element must have consistent value.)
For more information refer to *AMPL Configuration Advant Controller 100 Series Reference Manual.*

4.3.8.7 Scanning of Process Inputs

All analog and digital process inputs are scanned cyclically with the cycle time of the executable unit in which these inputs are consumed. See also Section 4.3.7.2, Process Communication.

4.3.8.8 Data Transport

Input Phase with GET Elements

Each execution of an execution unit begins with an input phase. This means that all PC elements in the execution unit have input data which is read on the same occasion. The way of associated data during the complete execution is illustrated with the example in Figure 4-7.

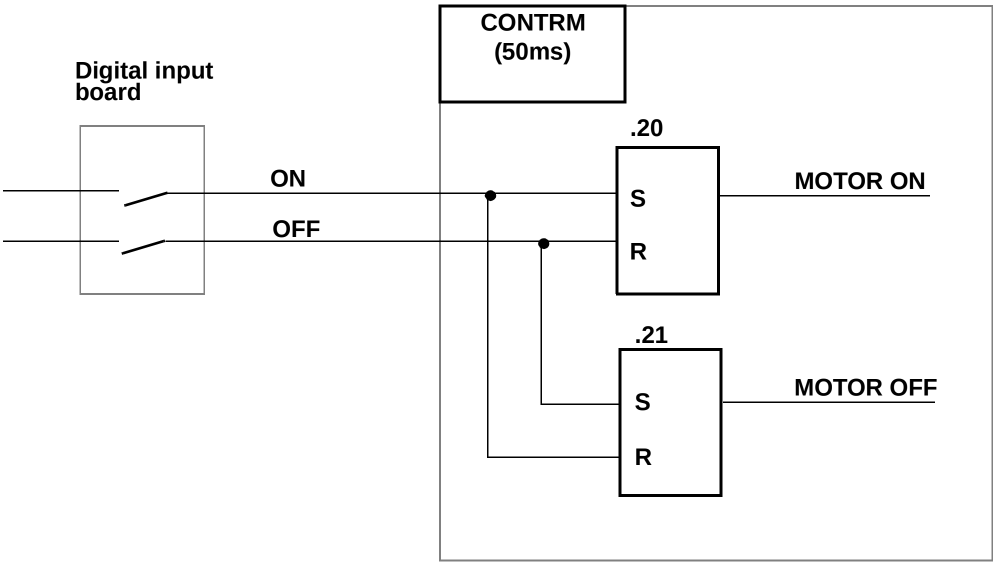


Figure 4-7. Example of Reading-in Phase

Assume that execution of element .20 is followed by an interrupt and the digital input signal changing status from 1 to 0. When the execution is resumed with element .21, the signals MOTOR ON and MOTOR OFF are active simultaneously. The system automatically introduces a ("invisible") GET which reads the values of the input signals at the beginning of the execution of the unit and stores them in the local data area to prevent such faults.

Output Phase with PUT Elements

The execution of all execution units is concluded with an output phase. This means that output data from the execution unit is obtained from the executions of all of the PC elements in the unit.

The following example illustrates the requirements for PUT elements. Assume two execution units with the cycle times 500 ms and 50 ms, respectively, see Figure 4-8.

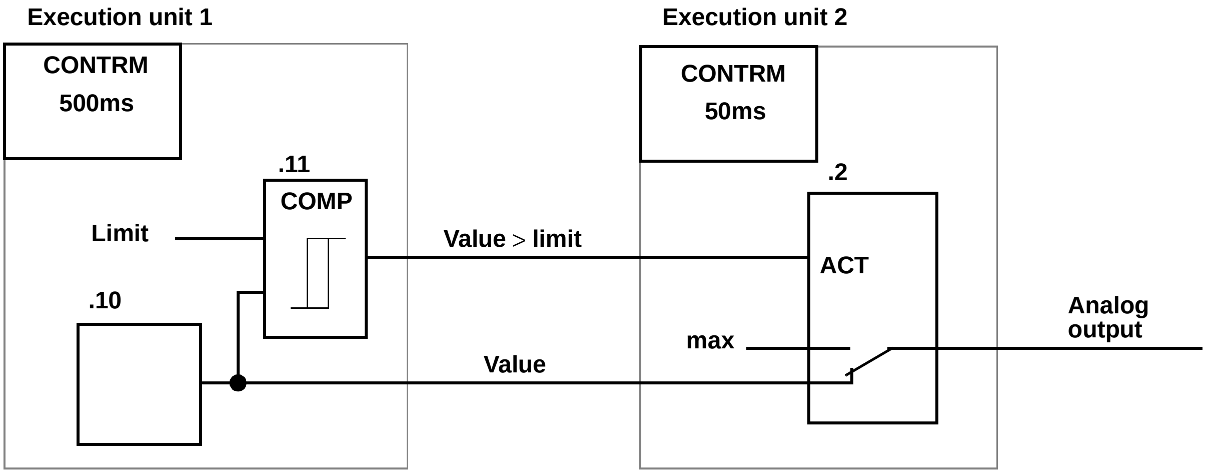


Figure 4-8. Example of Reading-out Phase

A value is calculated in the execution unit 1 with the cycle time 500 ms and a limit check is performed on the calculated value. These values (VALUE and VALUE > LIMIT) are connected to an execution unit with the cycle time 50 ms where the logical signal VALUE > LIMIT controls an analog output with a fixed value MAX or with the calculated signal VALUE. Assume that when element .10 has been executed (but not .11), an interrupt signal with the cycle time 50 ms interrupts the execution unit 1. The PC element in this unit works with the values of the signals VALUE > LIMIT and VALUE, which are not associated with one another. To prevent this, the system automatically introduces an ("invisible") PUT element.

The purpose of the PUT element is to ensure that the output signals from an execution unit only become legible for PC elements within other execution units when all PC elements within the unit have been executed.

Data Transport Between Execution Units

The data transport to input and outputs which are represented by DB elements is executed by GET elements and PUT elements.

The data transport between execution units is organized in the same way. The output to a PC element of another execution unit uses a PUT element which writes to a data area for data exchange between executable units. The input of the other execution unit reads via GET element from the corresponding location in that data area. The engineering station automatically inserts the necessary PUT and GET elements which are "invisible". You just make a connection between PC elements independent whether they are part of the same executable unit or not.

Chapter 5 Maintenance

5.1 Preventive Maintenance

This chapter describes routine maintenance, replacement, and installation procedures necessary to maintain the operation of an Advant Controller 110.
You can reduce future maintenance effort already during configuration and application building phase of your controller project. See Section 3.1.9, Module Types and Programming Style.

5.1.1 Safety Regulations

Always follow the instructions below when installing and operating an Advant Controller system to minimize the risks of injury to personnel and damage to the equipment. Local statutory regulations, to the degree that they are stricter than the following, take precedence.

5.1.1.1 Personnel and Process Safety

DANGER - CAUTION

Observe the following:

- Use only approved hoisting equipment when lifting cabinets. See lifting instructions enclosed with the cabinet.
- Never switch on the voltage supply of the cabinet during installation work. However replacement of modules in subracks can be done on line, that is, while power supply is switched on. Special instructions are given for the work with power supply units.
- Power supply units in a "live" system, i.e while the mains supply is switched on, is to be **replaced by authorized service personnel only.**
- Work with care when supply voltage is applied in the system. The voltage in the cabinet can cause injury and can even kill a human being.
- Make sure that everyone working on the installation knows the location of the safety switch and the mains power supply switch to the Advant Controller 110 equipment and how to use it.
- When the subsections of the process are checked and a test run has been performed, a responsible person is to check out interlocking chains, and so on.
- Inform all assembly personnel about test runs to be performed.
- Process technicians are to be present when testing and operating the process objects.
- Never press the INIT (initialization) button of the processor module if you do not know what happens in the system with an initialization.
- Remember that the control system can be controlled from an engineering station connected at another node via Advant Fieldbus 100. For example it can be stopped, configured, and started remotely.
- Remember that an Advant Controller 110 starts automatically when voltage is applied. You can also prevent start-up of an Advant Controller 110 by setting the START MODE selector in the STOP position.

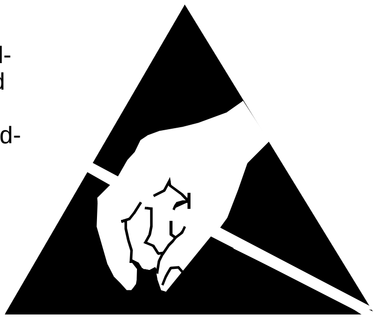
5.1.1.2 Machine Safety

CAUTION

Observe the following safety rules:

- Avoid discharges of static electricity by grounding both yourself and tools before handling circuit boards and other parts of the equipment.
- Use the grounded wristband installed in the cabinet and the available folding working surface (service shelf) when handling parts of the system.
- Handle the modules carefully, particularly those which contain MOS components which can be damaged by static electricity discharges. Note the warning label on the modules.
- Use, as far as possible, the grounded wristband when handling modules not stored in envelopes of conductive plastic. This gives optimum protection against static electricity discharges.
- Always store modules in envelopes of conductive plastic when not installed in the system rack.
- Always switch off the voltage before extracting a module which cannot be exchanged while under voltage. Wait a sufficient time for the capacitors to discharge.
- Switch off voltage to the system and withdraw all boards at least 20 mm before electrical welding is performed near the controller system.
- A warning label is fixed in the system to draw attention to possible damage by ESD (Electro Static Discharge).

All elektronik är känslig för ESD (elektrostatisk urladdning). För att undvika onödiga skador vid hantering av kretskort rekommenderas användning av systemjordat handledsband med inbyggt skyddsmotstånd samt antistatisk förvaringspåse för korten.



All electronic devices are sensitive to ESD (electrostatic discharge) effect. To avoid accidental damages while handling PC boards, it is recommended to wear wrist strap earthed to the chassis. Wrist strap has to have built-in protective resistor. Antistatic bag has to be used to store and transport the PC boards.

Figure 5-1. Warning Label Regarding ESD

5.1.2 Visual Inspection

Inspect the Advant Controller and the I/O cabinets at regular intervals determined by environmental factors such as vibration, air pollution, ambient temperatures, and so on.

5.1.3 Safety

Check that all screwed joints and connections within the cabinets are tightened effectively. Ensure that wiring, circuit boards, and other electrical components are undamaged. Pay particular attention to overheating, damaged insulation, or signs of wear.

5.1.4 Cleanliness

Remove dust and any other soil from the cabinet with a vacuum cleaner. Use a lint-free cloth, dampened with methylated spirits to remove stubborn dirt.

5.1.5 Air Filter

Wash the air filter included with the equipment in warm water with a mild detergent at regular intervals determined by environmental conditions. Replace the filter after three such washings. The new filter must be approved as a spare part.
Certain versions of cabinets include air filters. Refer to the actual installation for further information.

5.1.6 Batteries Modules

If a lithium battery module SB610 or SB611 (backup for the processor module RAM and timer) is used, an error message is generated if the battery module needs to be replaced.

5.1.7 Forced Cooling

If a fan is fitted, check its operation also.

5.1.8 Hardware Indicators

Most of the replaceable hardware modules are equipped with LED indicators.

- A green LED indicating running.
- A red LED indicating fault.
- A yellow LED indicating an active signal.

Some modules provide the additional yellow LEDs for increased maintainability, for example, send and receive information on communication modules.

The diagnostic display on the processor module indicates

- Processor module status
- Halt codes in case of a severe fault with discontinuances of the program.

You can find solid information along with the halt code, error message, and fault finding descriptions in Section 5.2, Error Messages and Section 5.3, Fault Finding and User Repair below.

5.1.9 Indication on Modular Front of S600 I/O Modules

The meaning of the LED indicators of S600 I/O modules can be found in *S600 I/O Hardware Reference Manual*.

Between two and 34 LED indicators are located at the left-hand edge on the front of the modules. The two uppermost LEDs on all modules are FAULT and RUN. FAULT is a red LED indicating a module failure. RUN is a green LED and indicates that the module is configured and operating normally.

Digital input and output modules have a yellow LED for each channel to signal the status of the channel. The LED lights when the channel is “ON” (=1). The LEDs are located beside the fields with the channel numbers, making it easy to see the status of each channel.

RUN (Green LED):

The Advant Controller 110 system software checks that the modules are installed correctly and are not signaling a defect. A plausibility check of the following is performed during power-up:

- Module type
- Position
- Process connector on/off.

After the check is completed successfully, the RUN LED of the module is set.

FAULT (Red LED):

If a severe fault is detected by the I/O module itself, the FAULT LED on the front of the module lights and the internal input signals are set to “0.”

5.2 Error Messages

5.2.1 Fault Classification

Beside faults in the power supply system (see Section 5.4, Basic Fault Tracing) and faults which give no indication (see Section 5.5.1, Fault Tracing by Interpretation of Fault Symptoms) there are two main categories of faults in an Advant Controller 110 system:

- Severe faults stopping the system
    - Halt codes are shown on the diagnostic display on the processor module front
    - More detailed information can be read by an engineering station.
    - Should the red LED FAULT on the processor module front light the processor module itself is most probably defective.
- Faults not stopping the system
    - Error information is accessible by an engineering station.

For both categories of faults (see Section 5.2.5, Faults Stopping the System and Section 5.2.6, Faults Not Stopping the System) you can read error messages by an engineering station using the Function Chart Builder command **Target | Diagnostics | Target | Report Errors**.

This command shows the error report of your Avant Controller 110 system. The error report lists the all detected errors with error type (see Section 5.2.3, Error Report).

Several kind of errors are grouped to a certain error type (see Section 5.2.2, Error Types). To get the specific error message 'behind' an error type just make a double click on the error line.

The error message indicates significance and corrective action (see Table 5-3 and Table 5-4).

5.2.2 Error Types

Errors are classified into several types as listed in Table 5-1. The error type is used for both category of faults which stop or do not stop the system. The error type is shown in the error report (see Section 5.2.3, Error Report).

Table 5-1. List of Error Types

Type of Error	Significance
Application error	There is an error in your application program.
Communication error	An error occurred during communication.
Configuration failed	There is a mismatch between DB part of your application program and the hardware configuration of your controller system.
External hardware error	There is a hardware error outside processor module.
Fatal error	There is a fatal error. The corresponding module has to be exchanged.
High system load	The load generated by the running application is too high (warning).
Internal hardware error	There is a hardware error on the processor module.
Module is missing or not accessible	The module did not respond.
Module type does not match database	There is a difference in types between the I/O module on specified position in the station and that configured in DB part.
Power failure	Indicates that the AC 110 was switched off or that there was a power failure.
Process error	The diagnosis detected a process error on specified I/O module.
Unknown error	The type of error is not known by the Advant Controller 110 system.
Start of application from PROM failed	There is an application in FPROM of processor module which is incompatible to system software or software options.
System error	The processor module is not working correctly due to severe system software error during runtime.
System overload	The system is overloaded and stops. The load generated by the running application is too high.
Wrong firmware	Firmware on module is not supported.

5.2.3 Error Report

To get an error report of your Advant Controller 110 system you just connect an engineering station to the processor module and activate the Function Chart Builder command **Target | Diagnostics | Target | Report Errors**. (see Figure 5-2)

This command shows the error report of your Avant Controller 110 system. The error report indicates whether the system's diagnostic function has detected any fault or otherwise abnormal condition.

Apart from messages of non-fatal errors, such as I/O module errors, the error report also includes messages for errors which lead to a system stop.

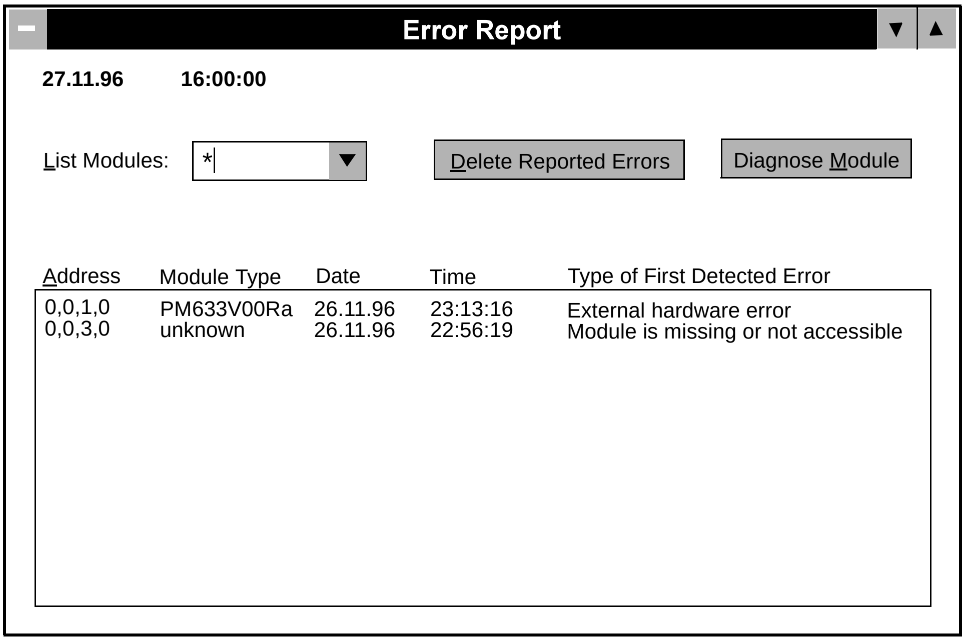
The error report shows the first occurred error if a module has several errors (see "First Detected Error" in Figure 5-2).

For tracing module or system errors, you can delete all reported errors by pressing button *Delete Reported Errors.* All errors including those not shown because a module has several errors will be deleted. Errors that are permanently present in the system are inserted again with an updated time stamp

The error report lists the all detected errors with error type (see Section 5.2.2, Error Types).

Several kind of errors are grouped to a certain error type. To get the specific error message "behind" an error type just make a double click on the error line which activates the module diagnostic function (see Section 5.2.4, Module Diagnostic).

For more information about error report refer to *AMPL Configuration Advant Controller 100 Series Reference Manual.*



27.11.96 **16:00:00**

List Modules: *

Address	Module Type	Date	Time	Type of First Detected Error
0,0,1,0	PM633V00Ra	26.11.96	23:13:16	External hardware error
0,0,3,0	unknown	26.11.96	22:56:19	Module is missing or not accessible

Figure 5-2. Report Error Window, Example

Error reports generated by the Advant Controller 110 have the following format (see also the figure above).

- Address: For I/O module errors the address of the related module is split in "bus," "station," "substation * 100 + position", and "subposition":

  bus:
  Always zero, since the error report is performed locally on processor module.
  station:
  Describes the station number (within AF 100 control net) of the station in which the faulty module is placed.
  substation * 100 +position:
  Substation describes the station number of the I/O station in which the faulty module is placed.
  Position describes the position number on which the faulty module is placed.
  (Example: substation = 3, Position = 18, substation *100 + position = 318)
  subposition:
  Describes the subposition of the faulty module (only displayed for SC610 and submodules, 0 = no submodule, 1 = submodule in upper subposition, 2 = submodule in lower subposition).

Module Type:	Module type, for example, PM633.
Date:	Date the error first occurred.
Time:	Time the error first occurred.

- Type of First Detected Error: Error type (see Section 5.2.2, Error Types)

  One error entry is reserved in the report per module, that is, the first error detected on this module is reported.

5.2.4 Module Diagnostic

When you chose the error report function by an engineering station using the Function Chart Builder command **Target | Diagnostics | Target | Report Errors** you get the module diagnostic function by a double click on the error line.

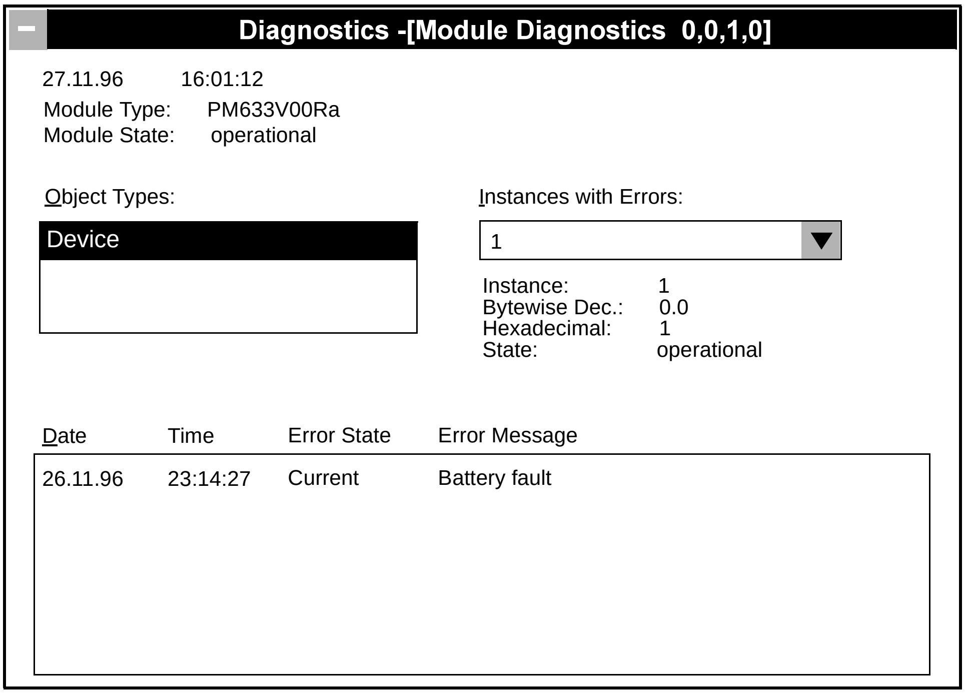
The module diagnostic function lists all the error messages and object types of the chosen module (see Figure 5-3). By default you get the error message of the device object.

Module objects are fictive items of the system software which are assigned to the module itself (for example, device object, digital input channel object) or to DB elements (for example, Data Set) or other parts of the system. Module objects will show you which parts of the system have a fault.

Error state of module diagnostics (see Figure 5-3) describes whether the error is still present or not. Error state can have 3 values:

Current:	Error is still present.
Transient:	Error was detected but is not present any more.
Detected:	Error was detected but it is unknown whether error is still present.

For more information about module diagnostic refer to *AMPL Configuration Advant Controller 100 Series Reference Manual*.



27.11.96 16:01:12
Module Type: PM633V00Ra
Module State: operational

Object Types: Device

Instances with Errors: 1

Instance: 1
Bytewise Dec.: 0.0
Hexadecimal: 1
State: operational

Date	Time	Error State	Error Message
26.11.96	23:14:27	Current	Battery fault

Figure 5-3. Example for Module Diagnostics of Device Object

Table 5-2. Module Objects

Module Objects	**Comments**
Device	
Digital input channel	
Digital input supervision	
Digital output channel	
Analog input channel	
Analog input limits	
Analog input register	
Analog output channel	
Analog output register	
High speed counter	For pulse counter module
High speed counter 2	For pulse counter module

Table 5-2. Module Objects (Continued)

Module Objects	Comments
Bus extender	
Data Set	
MasterFieldbus master	
MasterFieldbus slave	
MVI channel	
MVI node	
MVI data block	
Event handler	For DI65x
Event receiver	For DI65x
PROFIBUS-DP master	For PM634
PROFIBUS-DP slave	For PROFIBUS I/O devices

5.2.5 Faults Stopping the System

Faults which stop the system can be caused by a defective processor module.

In the case of a severe fault, which stops the CPU, a two-digit error code is presented on the processor module's diagnostic display. Should the LED FAULT light, the processor module itself is most probably defective.

Fatal errors are stored in the processor module and can be read by the engineering station using the error report function (see Section 5.2.3, Error Report).

The following table defines all error codes which are displayed at diagnostic display of the processor module, their names, and their significance. It also gives hints on what action you should take.

If an error is marked with HALT communication via serial interface of processor module to engineering station is still working. Thus you can read the error report immediately by an engineering station using the Function Chart Builder command **Target | Diagnostics | Target | Report Errors**.

If an error is marked with STOP communication via serial interface of processor module to engineering station is not working. Thus you should restart the system by pressing the INIT button with START MODE selector in STOP position to read the error report.

The error report shows the Type of Error. To get the specific error message "behind" an error type just make a double click on the error line. Then the module diagnostic of the processor module will appear. By default you get the error message of the device object which corresponds to the processor module.

Table 5-3. Error Codes on Diagnostic Display of Processor Module

Error Code	STOP/ HALT	Type of Error	Error Message / Significance	Corrective Action
01	HALT	Unknown error	Unknown error / The reason for this error is unknown.	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Reload the application program and try again. Replace the CPU module PM632/PM633/PM634. Report error to support line.
05	HALT	Internal hardware error	Bus error in memory / The processor tried to access a nonexistent memory location. This indicates a serious system software error or defective hardware.	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Replace the processor module PM632/PM633/PM634.
06	HALT	Internal hardware error	BIM3 defect / This is a hardware problem.	Replace the processor module PM632/PM633/PM634
09	HALT	Internal hardware error	Stall timer time-out / This is a software problem and indicates that the CPU is not working correctly. It is probably caused by a CPU overload.	Restart the system by pressing the INIT push button with the START MODE selector in the STOP position. Extend the cycle times of execution units in the PC program or remove one or more execution units, e.g., control modules, and load and deblock the application again.
0A	STOP	Internal hardware error	RAM fault / The error code appears during the RAM test, which is performed during system initialization.	Replace the processor module PM632/PM633/PM634.
0C	STOP	Internal hardware error	CPU instruction set fault/ This is a hardware problem.	Replace the processor module PM632/PM633/PM634
0D	STOP	Internal hardware error	Timer fault / This is a hardware problem.	Replace the processor module PM632/PM633/PM634

Table 5-3. Error Codes on Diagnostic Display of Processor Module (Continued)

Error Code	STOP/ HALT	Type of Error	Error Message / Significance	Corrective Action
26	HALT	Start of application from PROM failed	Wrong configuration data of processor module / The processor module could not start the application due to unknown configuration data.	Check your application program for correct configuration data.
27	HALT	Application error	Not enough memory for application available / The processor module could not start the application due to lack of memory.	Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then remove all loaded but unused options which may consume memory by loading BASE software. Enable only necessary options and restart the system by pressing the INIT push button with the START MODE selector in CLEAR position. Reduce size of application. Avoid on-line changes on processor module.
42	HALT	System overload	System overload / The processor module was not able to run the specified control module. The control module could not be completed within the specified cycle time and was aborted.	Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then reduce the load by extending the cycle times, for example, of control modules in the PC program or remove one or more execution units, e.g., control modules. Load and deblock the application again. Avoid on-line changes on processor module.
44	STOP	Internal hardware error	System PROM fault / This indicates that the memory used for storing the system software could be defective.	Reload the system software and try again. Replace the processor module PM632/PM633/PM634.
46	STOP	Internal hardware error	Serial communication device defect / This is a hardware problem.	Replace the processor module PM632PM633/PM634.

Table 5-3. Error Codes on Diagnostic Display of Processor Module (Continued)

Error Code	**STOP/ HALT**	**Type of Error**	**Error Message / Significance**	**Corrective Action**
49	HALT	System error	System error / Indicates an unexpected state, usually due to a system error.	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Reload the application program and try again. Replace the processor module PM632/PM633/PM634. Report error to support line if it above measures do not help.
4A	HALT	System error	Power failure	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.
4C	HALT	System error	CPU address error / This is a software problem and indicates that the CPU is not working correctly.	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Reload the system software. Replace the processor module PM632/PM633/PM634.
4D	HALT	System error	CPU exception / This is a software problem and indicates that the CPU is not working correctly.	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Reload the system software. Replace the processor module PM632/PM633/PM634.
51	HALT	Application error	Unknown function block called / Indicates that a function block (that is, PC element or DB element) has been called which the current system software does not recognize.	Load the correct system software or change the application program to match current system software.
54	HALT	Internal hardware error	OSP watchdog occurred / Indicates that I/O modules could not be accessed for a certain period and that the outputs were set to safe position (usually to "0").	Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. Reload the application program. Replace the processor module PM632/PM633/PM634.

Table 5-3. Error Codes on Diagnostic Display of Processor Module (Continued)

Error Code	STOP/ HALT	Type of Error	Error Message / Significance	Corrective Action
5D	HALT	Start of application from PROM failed	Incompatible application in PROM / This may occur after loading of a new system software.	Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then generate new target code with a matching release of the Advant Station 100 Series Engineering Station, download to PM632/PM633/PM634 and save it in PROM.
5E	HALT	Application error	Add-on option installation incomplete / Add-on option is faulty.	Correct your add-on option and load again.
5F	HALT	Start of application from PROM failed	Error in extended DB elements / Application with extended DB elements does not run	Restart the system by pressing the INIT push button with the START MODE selector in CLEAR or AUTO position. Load your application again. Report this error to support line.
63	HALT	Start of application from PROM failed	Missing option(s) / Indicates that the application in PROM needs an option that is not part of the system software (probably due to download of new BASE system software).	Restart the system by pressing the INIT push button with the START MODE selector in the STOP position. Then install the missing option and restart the system with the START MODE selector in either the CLEAR or AUTO position.

5.2.6 Faults Not Stopping the System

A list of errors that do not lead to a system stop is shown in the table below. This list contains the possible error messages and actions to take to correct those faults.

You can read the error report by an engineering station using the Function Chart Builder command **Target | Diagnostics | Target | Report Errors**.

The error report shows the Type of Error. To get the specific error message "behind" an error type just make a double click on the error line. Then the module diagnostic of the processor module will appear.

By default you get the error message of the device object which corresponds to the processor module. To get the error message of another object just click to that other object.

Table 5-4. Error Texts in Error Report

Type of Error	Error Message / Significance	Corrective Action
Application error	Add-on option installation incomplete / An Add-on option could not be installed during start up of processor module due to its system requirements.	Reduce the amount of installed Add-on options.
Application error	Event queue overflow in EVS / The event queue of an Event Set EVS(S) or EVS(T) has overflowed.	Check why events are generated faster than they are transferred to the event receiver. An extended event queue (terminal QUEUE=EXTENDED) may help.
Application error	Event receiver error in EVS / An Event Set EVS(R) or EVS(T) located on another station in the network requested events from a local Event Set.	Check the configuration of all EVS(T) and EVS(R) in the network (AF 100 or RCOM).
Application error	Event source error in EVS / An Event Set EVS(S) or EVS(T) has received events from an event source which is not referenced by this Event Set.	This error may occur after changes in the Event Set configuration. In that case, ignore this message, otherwise report to support line.
Application error	Wrong AF 100 station address in application / A difference between station address on station address selector at base station subrack and that in configuration data was detected.	Select the same station address in the engineering station.
Configuration failed	Access of communication interface failed / The AF 100 communication interface could not be initialized and is in a faulty state.	Check bus connections and termination of communication interface. Exchange the communication interface.
Configuration failed	Finish of configuration failed / It was not possible to write configuration data to the specified I/O module or to save them therein.	Load application again. Exchange the specified I/O module.
Configuration failed	Module configuration failed / An error occurred during configuration of specified I/O module.	Check the specified I/O module and all its process connections. Check configuration data in DB part. Exchange I/O module.
Configuration failed	Passive module detected / The diagnosis detected a passive I/O module.	Check process connections to all channels. Exchange I/O module.

Table 5-4. Error Texts in Error Report (Continued)

Type of Error	Error Message / Significance	Corrective Action
Configuration failed	Protocol type not supported / The type specified at MVICHAN DB element is not supported by MVI.	Use MVI that supports that protocol type. Specify protocol type at MVICHAN DB element that is supported by MVI.
Configuration failed	Read access to module failed / Internal error: It was not possible to read addresses from specified I/O module (only CI626 and CI671) - communication cannot be started.	For CI626/CI627: Delete error buffer - if this error occurs again, check CI626/CI627 itself and load on AF 100 and its configuration. Exchange the communication interface. For CI671: Exchange the communication interface.
Configuration failed	Read module parameter failed / Internal error: Configuration data could not be read from specified module.	Exchange the specified I/O module.
Configuration failed	Read signal parameter failed / Internal error: It was not possible to access data from specified I/O module.	Exchange the specified I/O module.
Configuration failed	Start of configuration failed / The I/O module did not respond when starting the configuration.	Exchange the specified I/O module.
Configuration failed	Write module parameter failed / Configuration data could not be written to specified I/O module.	Validate correct configuration data in DB part. Check process connections to all channels of I/O module. Load application again. Exchange I/O module.
Configuration failed	Write signal parameter failed / Configuration data could not be written to at least one channel of specified I/O module.	Validate correct configuration data in DB part. Check process connections to all channels of I/O module. Load application again. Exchange I/O module.
External hardware error	Battery fault / Voltage of the installed battery is too low.	Check voltage of the installed back-up battery and exchange it. If no battery is needed, suppression of this error message is possible by setting the attribute WITH_BAT on PM63x DB element to zero.
External hardware error	Bus error while module access / The CPU can not access the backplane bus.	If this error happens often replace processor module PM632/PM633/PM634

Table 5-4. Error Texts in Error Report (Continued)

Type of Error	Error Message / Significance	Corrective Action
External hardware error	No battery plugged / Back up battery is missing although specified in configuration data for PM63x.	Plug lithium backup battery or select zero for attribute WITH_BAT at DB element for PM63x to suppress this error message.
Fatal error	Fatal error / The specified I/O module has a fatal device error.	Exchange I/O module.
High system load	System high load / The load generated by the running application is too high. Danger of overload.	Reduce the load.
Internal hardware error	Application PROM fault / This indicates that the memory used for storing the application program could be defective.	Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then reload the application program and try to save it again in PROM. Replace the CPU module PM632/PM633/PM634.
Internal hardware error	Real -time clock defect / The real-time clock of the processor module is defect.	Replace the CPU module PM632/PM633/PM634
Module is missing or not accessible	Module is missing or not accessible / The module did not respond.	Insert or Exchange module.
Module type does not match database	Module type does not match database / There is a difference in types between the I/O module on specified position in the station and that configured in DB part.	Use the same type in station and in DB part.
Power failure	Power failure / Indicates that the AC 110 was switched off or that there was a power failure (complete base station or extension subrack of base station).	Check the power supply to the extension subrack of the base station.
Process error	Process error / The diagnosis detected a process error on specified I/O module.	Check process connections to each channel. Validate configuration data for the I/O module and configured channels. Exchange I/O module.
System restarted	System restarted / The CPU performed a restart due to an error or by external command (e.g. RCOM cold start command).	Check other error messages which may have occurred a short time before. Check the reason for extern restart command.

Table 5-4. Error Texts in Error Report (Continued)

Type of Error	Error Message / Significance	Corrective Action
System error	Activating channel failed / It was not possible to activate an I/O channel during configuration or diagnosis.	Check process connections to all module channels and validate configuration data. Exchange I/O module.
System error	Activating module failed / It was not possible to activate the I/O module itself (green RUN LED is probably off).	Check process connections and power supply for specified I/O module. Exchange I/O module.
System error	Write state control failed / It was not possible to activate, passivate, or to delete a channel of the specified I/O module.	Load application again. Exchange I/O module.
System error	Passivating channel failed / Internal error: it was not possible to passivate unused channels.	Ignore this message if the I/O device has been reported as a defective module previously and exchange that module if it is to be used further on. Otherwise, report this error to support line.
System error	Passivating module failed / Internal error: it was not possible to passivate the I/O module.	Ignore this message if the I/O device has been reported as a defective module previously and exchange that module if it is to be used further on. Otherwise, report this error to support line.
System error	System error / The diagnosis detected a system error on I/O module.	Check process connections of I/O module and configuration data in DB part. Read further diagnosis data with diagnosis tool.
Unknown error	Unknown I/O module error ## / An unknown error was detected on I/O module.	Report this error to support line.

5.3 Fault Finding and User Repair

In all situations when the controller has stopped you should carefully read the halt codes at the diagnostic display of the processor module and error messages available before you proceed. See Section 5.2.5, Faults Stopping the System and Section 5.2.6, Faults Not Stopping the System.

5.3.1 Introduction

Diagnostics are available in different forms for rapid localization of the source of the equipment malfunction. Hardware error is usually corrected by replacing the faulty unit, which is returned to ABB for repairs. The least replaceable unit is normally a module or an apparatus like a power supply unit.

Disturbances and system halt caused by software error are commonly solved by a manual system restart. Sometimes you must load the application program, reinforcing the need for actual backup copies. In such situations, it is strongly recommended that you take careful note of all available stored error codes and error messages before an eventual program loading and new initialization. Then contact ABB for further information.

External faults in process wiring and transducers can also affect the function of the controller. However, this type of fault is not discussed in this manual.

Debugging of PC programs is described in *AMPL Configuration Advant Controller 100 Series Reference Manual*.

5.3.2 Diagnostics

System level diagnostics, including the Advant Controller 110, have an error reporting and indicating structure that makes use of diagnostic information displayed at engineering or operator station (see Section 5.2, Error Messages), diagnostic displays, and LED status indicators to indicate the status of hardware (see Section 5.1.8, Hardware Indicators).

Comprehensive system diagnostics not only detect problems, but also let an operator know where a problem is located. The diagnostic features of the system provide for timely, reliable detection and notification of both software and hardware errors.

The diagnostic philosophy for the ABB Master system is that single-fault situations are detected and processed.

The diagnostics support the maintenance philosophy of fault isolation and replacement down to module or subassembly level.

Advant Controller 110 performs a variety of diagnostic and supervision functions to continuously monitor the correct operation of the whole system. Each of the modules has its own diagnostic functions. The CPU module monitors the system as a whole by collecting all the diagnostic information and checking the consistency of the hardware configuration and the application software.

The supervision functions are subdivided into the following groups:

- Problem detection
- Signalling the nature of the problem
- Automatic reaction to problems.

Each module is equipped with the two LED indicators, FAULT and RUN. During normal operation, the green LED RUN is lit on all modules. The red LED FAULT lights only if a problem occurs on the module.

A module indicating FAULT should be replaced by maintenance staff and shipped to an ABB repair center.

The status of the modules and the I/O signals is also indicated by the associated DB elements. Missing modules are also signalled by the function supervising the configuration on the associated DB elements. The status signals on the DB elements can be processed by the PC program in the same way as other signals. This feature enables you to include your own error handling routines in application programs, for example, to interlock control loops if important signals are disturbed.

Texts providing more detailed information about problems are displayed by the Advant Station 100 Series Engineering Station.

Severe problems (for example, component errors) in the central processing unit stop the system. These errors also switch a relay in the central processing unit. Digital outputs are set to the off state and analog outputs are set to 0 mA (0 V).

The diagnostic function displays an error code on the front of the CPU module to facilitate fault tracing.

The I/O modules supervise whether or not the process connector is correctly inserted. If the process connector is withdrawn, operation of the I/O module is immediately inhibited (that is, it is no longer in the RUN state), and the error is indicated on the associated DB element module and by the DB elements channel in the CPU. If the process connector is not inserted, the module cannot be switched to RUN.

The CPU checks the consistency of the module configuration specified by the DB elements and the actual configuration of the modules. This check is performed each time a module is switched on before it is switched to RUN. If the module installed does not correspond to the type of module specified by the module DB element, then the module is not switched to RUN and the error is indicated on the associated channel DB elements.

Modules without an associated module DB element are not switched to RUN.

5.3.3 Fault Tracing Principles

Fault tracing must be performed in a systematic and logical manner. Before starting up a system which has not been in operation, always check that:

- The mains voltage is connected
- All modules are installed properly
- All modules are in the correct position
- All connections are made correctly.

If these checks do not reveal the cause of a malfunction, continue with the procedure described in Section 5.4, Basic Fault Tracing, and then continue to Section 5.5, Advanced Fault Tracing. See Section 5.3.4, Start-up for instructions on how to restart a system after a fault has been revised.

A fast and simple method of fault tracing is to reduce the system to a minimum by withdrawing all modules except the processor module PM632/PM633/PM634 and the power supply. Then reinsert them, one by one, to their positions until the fault recurs.

5.3.4 Start-up

The Advant Controller 110 must be restarted after the system is forced to shut down by a severe fault.

You can do this using INIT, which results in a cold start with the START MODE selector in either the CLEAR or the AUTO position.

Attempt to diagnose the fault before restarting any system displaying error codes. This can consist, for example, of noting error indications and error codes, or starting up the system with the START MODE selector in the STOP position and reading out the error report with the engineering station.

5.3.5 Safety

CAUTION

Read Section 5.1.1, Safety Regulations before beginning to trace a fault.

5.3.6 Process Output Behavior

See Section 3.1.11.1, Process Outputs Behavior at Interruptions for behavior of control outputs in case of faults.

5.4 Basic Fault Tracing

5.4.1 Equipment

The signal LEDs provided on the Advant Controller 110 are normally sufficient for tracing faults. The following equipment, however, simplifies the work and should be available:

- A multimeter
- Standard hand tools
- The system documentation according to Section 1.5, Related Documentation
- Spare modules and fuses.

5.4.2 Fault Tracing Procedure

The following diagram shows the suggested fault tracing procedure. The numbers indicate the sequence of the fault tracing steps. You will find helpful information about each step on the following pages.

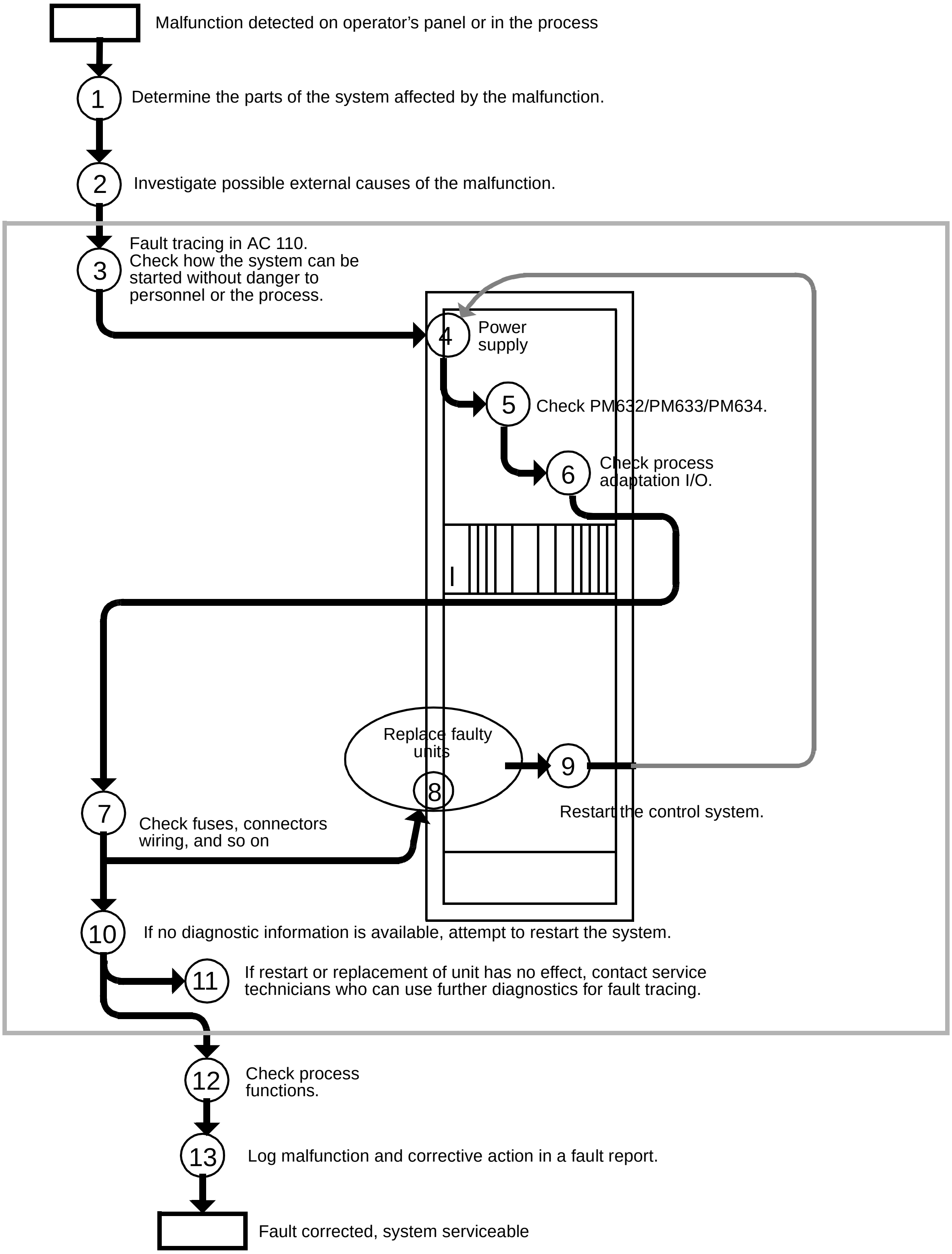

Malfunction detected on operator's panel or in the process
1
Determine the parts of the system affected by the malfunction.
2
Investigate possible external causes of the malfunction.
3
Fault tracing in AC 110.
Check how the system can be started without danger to personnel or the process.
4
Power supply
5
Check PM632/PM633/PM634.
6
Check process adaptation I/O.
I
Replace faulty units
8
9
Restart the control system.
7
Check fuses, connectors wiring, and so on
10
If no diagnostic information is available, attempt to restart the system.
11
If restart or replacement of unit has no effect, contact service technicians who can use further diagnostics for fault tracing.
12
Check process functions.
13
Log malfunction and corrective action in a fault report.
Fault corrected, system serviceable

Figure 5-4. Fault Tracing Procedure

(1) Locating the Cause of a Malfunction

Information displayed on the operator’s panel and from the process can give some indication as to where a fault is located.

Experience shows that approximately 85 percent of all faults occur in the process itself, 10 percent in the application program and five percent in the control system hardware.

It is always advisable to follow this procedure to locate the cause of a malfunction to minimize downtime.

(2) External Influences

In an electronic system which has been operating satisfactorily, most malfunctions have external causes. It is, therefore, important when you trace a fault to determine if any external factor such as incorrect handling of equipment, welding work, lightning and/or power failure has caused the malfunction.

(3) Safety When Starting up and Shutting down

The Advant Controller 110 can only perform its control functions when in normal operation.

Voltage failure, a component fault, or restarting manually usually affect the operation of the control system. Control system failure affects the process in different ways of varying gravity:

- In a control system with a monitoring character, changes of process status are not registered, but there is no immediate danger to the process.
- Control of continuous processes demands a high degree of availability from the control system. Restarting the Advant Controller 110 in such situations can have very serious consequences.

It is, therefore, important to be aware of the local conditions and safety requirements when you start and stop the Advant Controller 110.

(4) Checking the Power Supply

An Advant Controller 110 station can be supplied in one of two ways by using:

- SA610 power supply modules
- An external 24 V DC power source SA 161.

Power supply module SA610

As long as the green LED RUN on the SA610 lights, the 24 V station voltage is available. The 24 V station voltage can be measured on the USA, USB, and ZD terminals of the subracks.

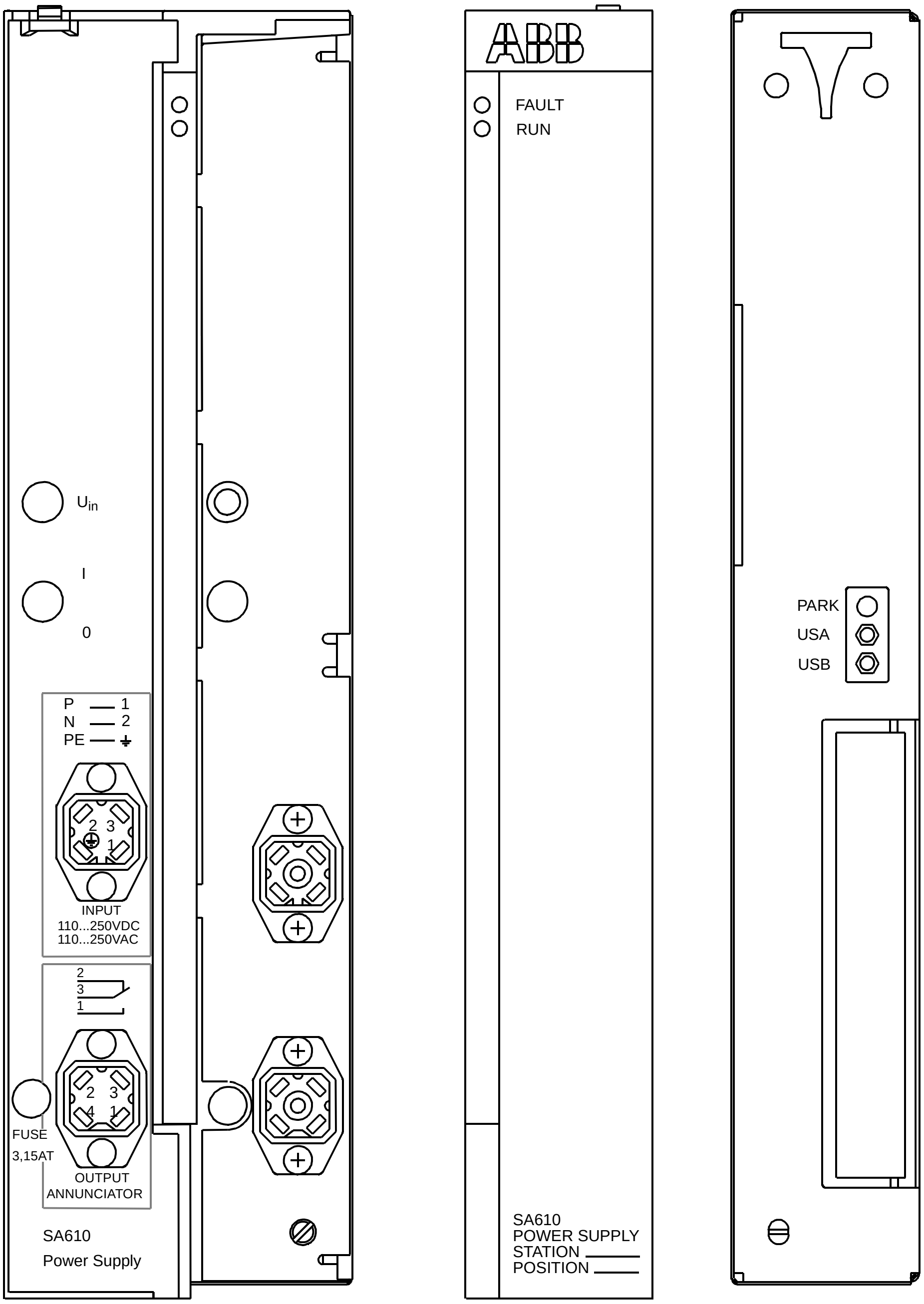
If the red LED FAULT lights up on the SA610, there is an overload or a short-circuit on the 24 V station voltage.

If the green LED RUN does not light, proceed as follows:

- Check the on/off switch on the power supply module.
- Check the green LED Uin, which indicates the presence of input voltage (mains voltage, for example, 220 V AC). If Uin is missing, check the fuse in the power supply module and then other fuses, circuit-breakers, and so on.

NOTE

24 V should be available on both station voltage lines (USA and USB).



Front door open

Front door close

Rear view

Figure 5-5. Front and Rear Views of Power Supply Module SA610

External Power Source SA 161

Illumination of the LEDs marked RUN on the CPU and other modules indicates the presence of their station voltage. The station voltage can be measured on the terminals USA and USB and ZD on the subrack.

The station voltage must be in the range 18 - 30 V DC. If it is too low, the modules probably will not function correctly.

(5) Checking the Processor Module and Bus Extender

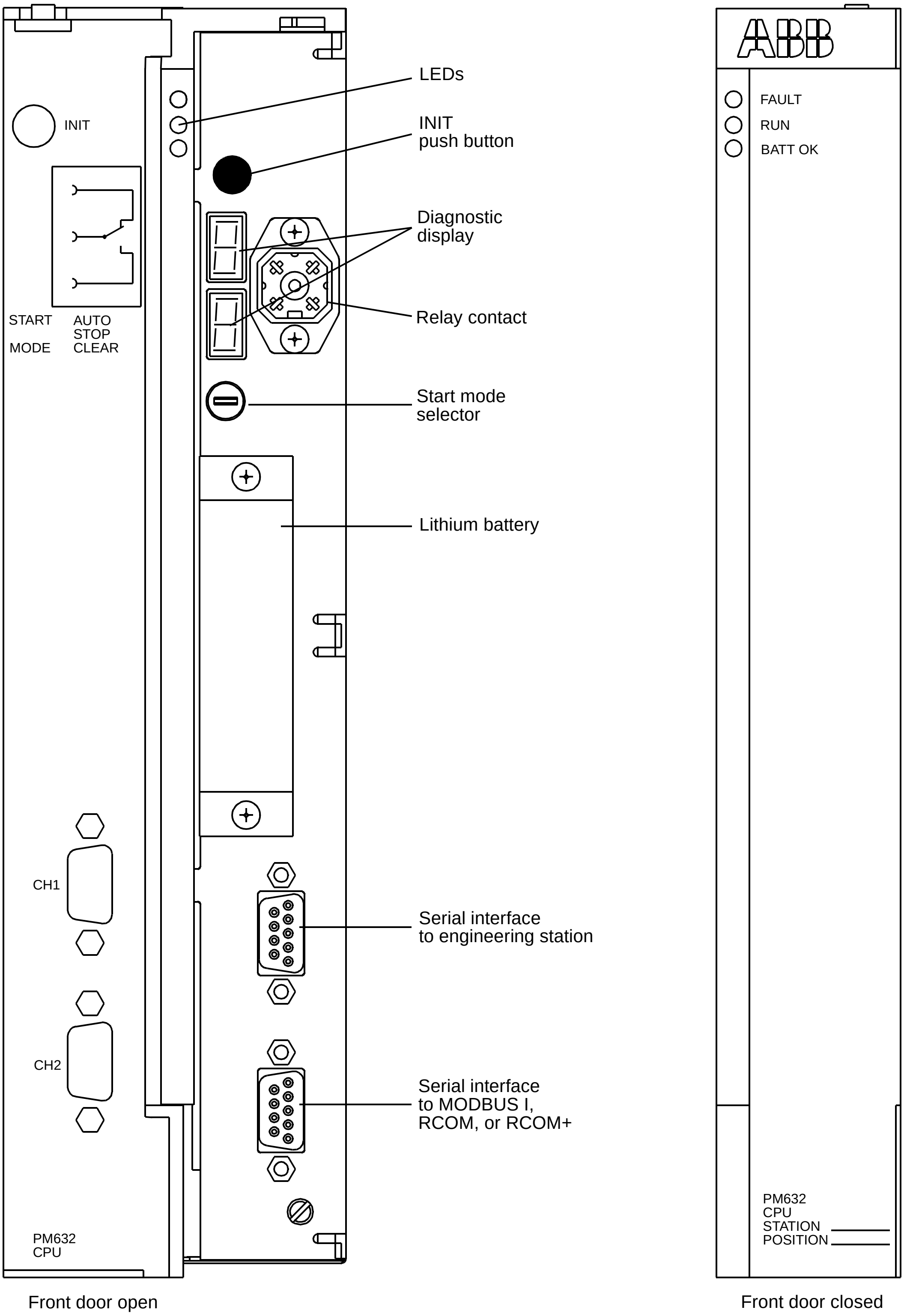


Figure 5-6. CPU Module PM632 with Open Front Door and Front View

Processor Module PM633:

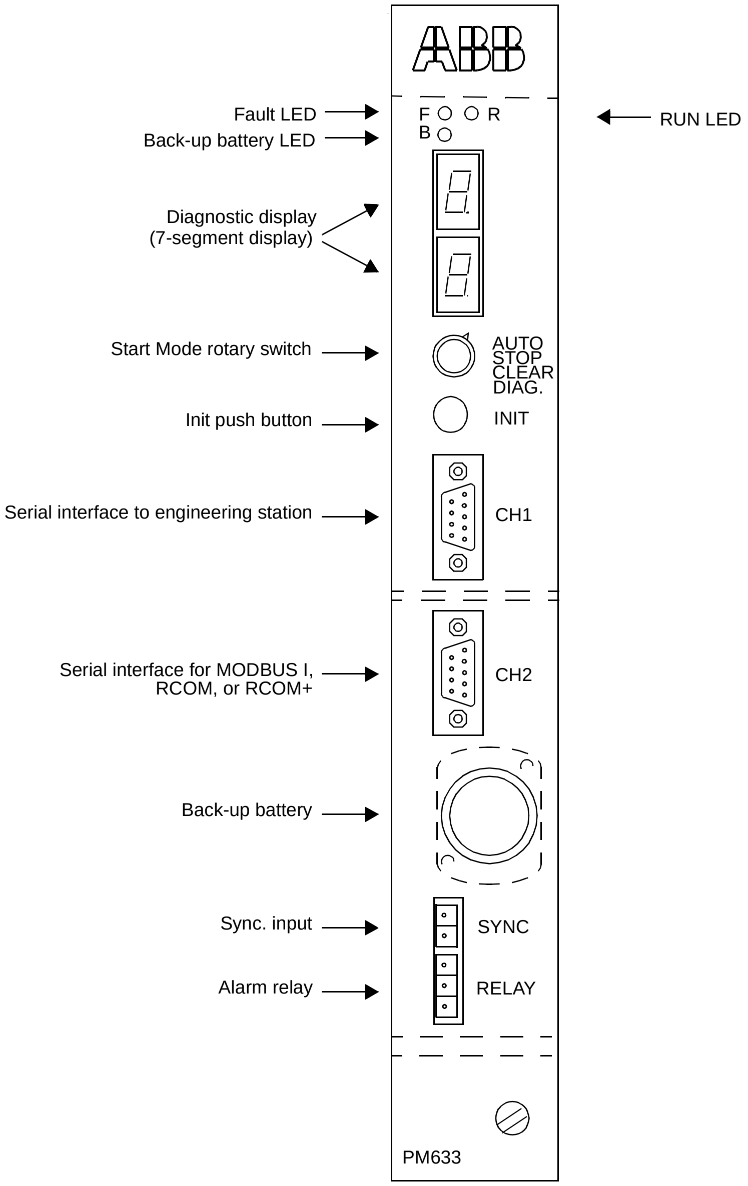


Figure 5-7. PM633 Front View

Processor Module PM634

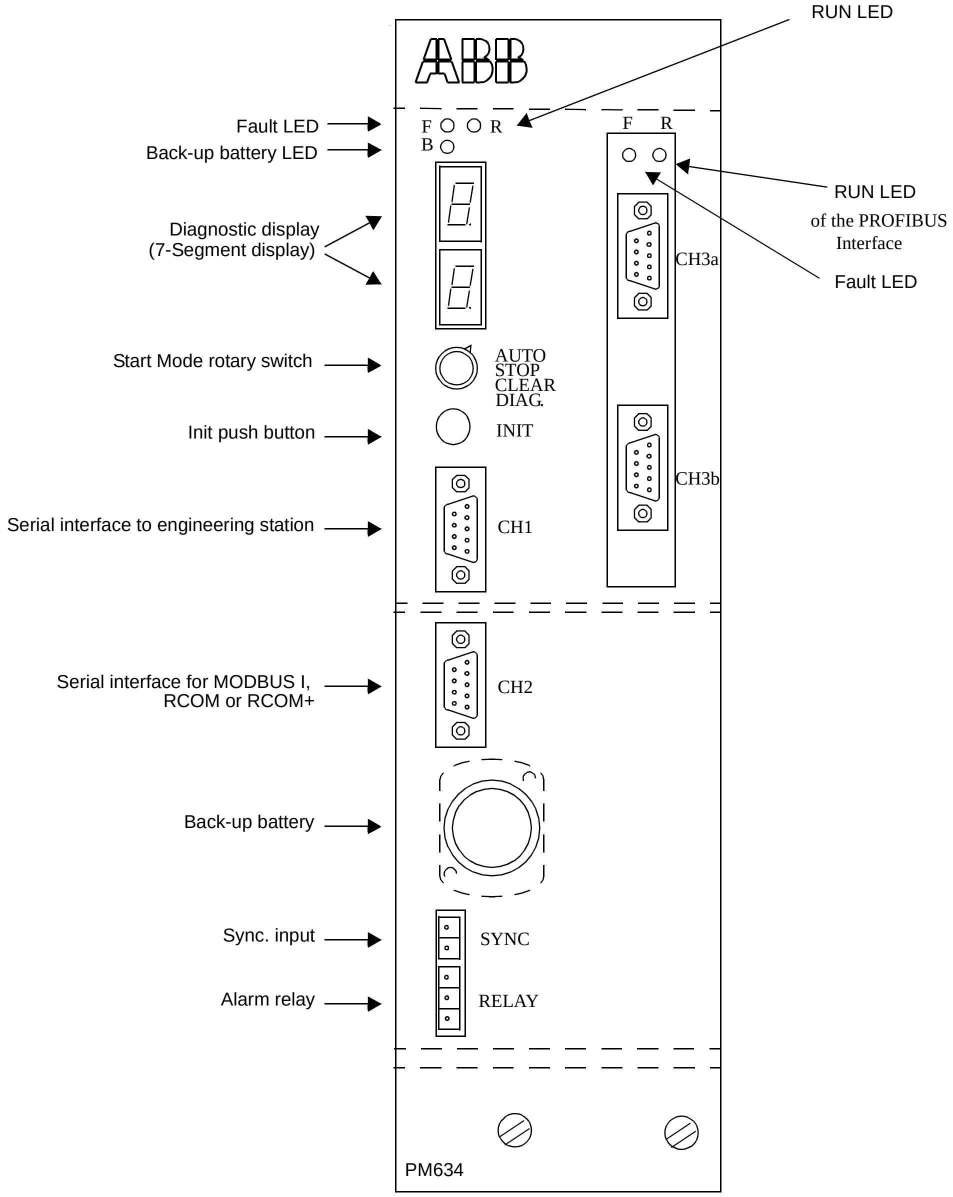


Figure 5-8. PM634 with PROFIBUS-DP Interface Front View

Check the following signals on the processor module PM632/PM633/PM634:

- The green LED RUN indicates that the processor module is operational.
- The red LED FAULT indicates a severe fault and normally the processor module must be replaced.

- The green LED BATT OK indicates that the backup battery supply for the RAM and the real-time clock is intact. Should this LED go out, the battery module SB610 or SB611 must be replaced (if fitted at all).
- The diagnostic display indicates the processor module operating mode:

  P- = start-up

  P1 = normal operation

  P3 = stop after initialization

  P4 = CPU is not running an application

  P5 = loading application program from PROM

  P6 = engineering station is connected and is in the on-line mode

  PL = waiting for download of system software

  PU = loading system software option (enabling options)

  xx = error code.

If a two-digit number (xx) is visible, the system has stopped and the number represents an error code.

Bus Extender CI615

In addition to its function as a bus extension, the bus extender module CI615 (Figure 5-9) installed in the base station (that is, the station with the processor module) contains the communication and bus cable supervision functions.

- The green LED RUN indicates that the bus extender is operational. If RUN does not light on a CI610 (in the I/O station), it probably cannot be accessed or activated. Check the I/O station address (on the station address switch).
- The red LED FAULT indicates a severe fault and normally the bus extender module must be replaced.
- A flashing LED TRANSFER indicates data read and write via the extension bus.

If the LED TRANSFER does not light on the CI615 (but the processor module is operating), it is possible the extension bus is not properly connected or fitted. Check the bus connections and bus terminator TC610.

NOTE

If the LED TRANSFER on a CI610 does not lit, all outputs on the I/O station are set to "0."

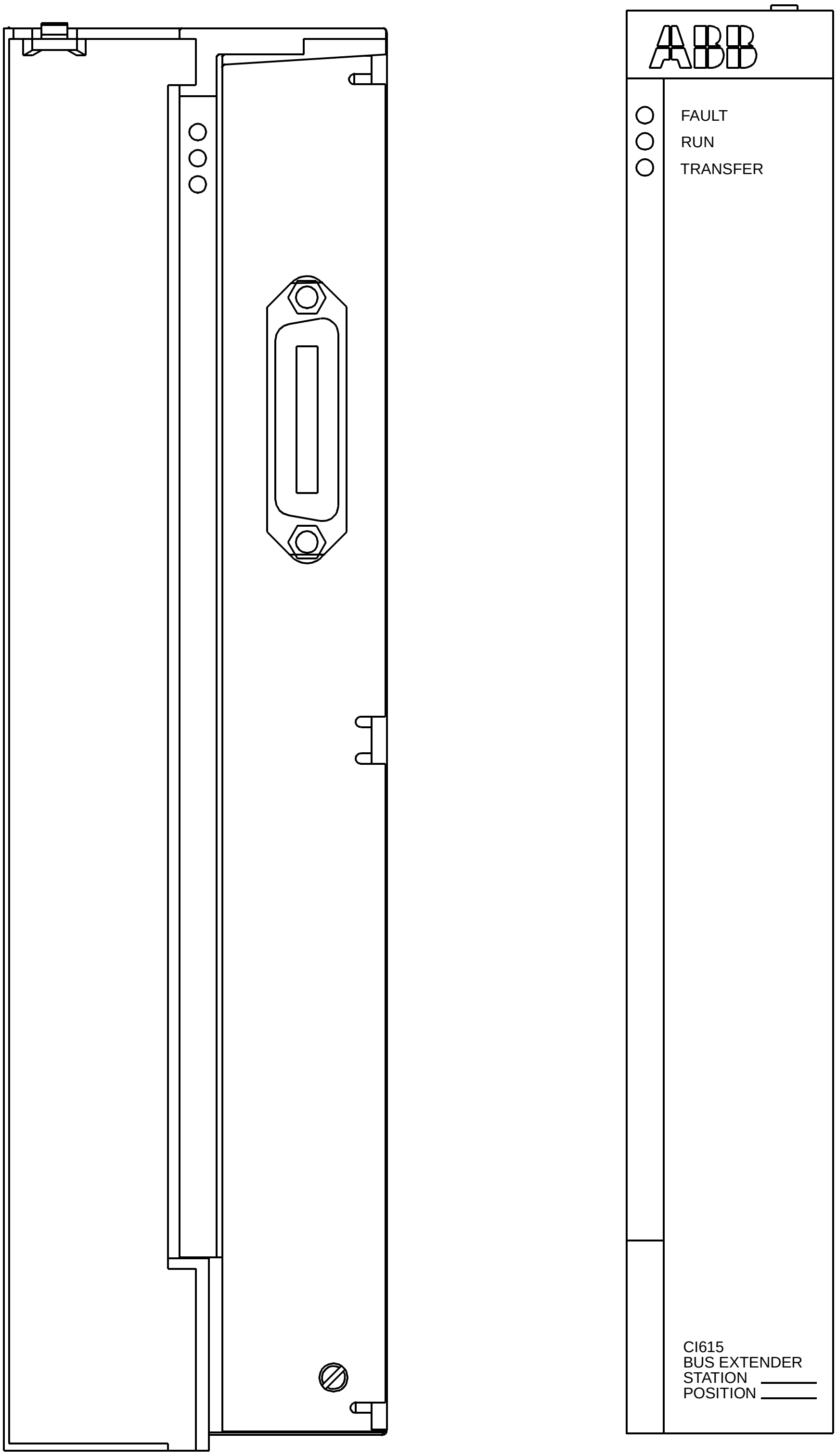


Figure 5-9. Bus Extender Module CI615 with Open Front Door and Front View

(6) Checking the Process I/Os

Check the LEDs FAULT and RUN (refer to Chapter 3, Configuration).

- RUN = module in the active (RUN) state.
- FAULT = severe fault detected by the module's self-testing facility.

Action to take in case of a FAULT signal:

- Replace the module with the LED FAULT lit. The LED FAULT always indicates a severe fault which can normally be repaired only in the factory.

Action to take when there is no RUN signal:

- Check whether the process connector is properly fitted.
- Check if the module is activated in the corresponding DB element (IMPL=1 requires an engineering station).
- Try to get more information via error report (requires an engineering station).
- If all of the modules with unlit RUN LEDs are in the same I/O station, the fault is probably in the bus extender module CI610 or in the bus cable or the I/O station address is wrong.

Status of I/O Signals

The status of the digital signals (DI, DO) is indicated by a yellow LED for each signal connected to the process:

- Digital input signals: The signal status LED is located in the input signal path, that is, it directly indicates input current.
- Digital output signals: The signal status LED is internally driven, that is, it indicates the internal output signal status (except the status LED of the DO610, which is driven by the process voltage).
- Check the process voltage supply and fuses for process signals. Fuses or circuit-breakers are the most frequent cause of missing process signals.
- Check the signal levels at the terminals of the process connector.

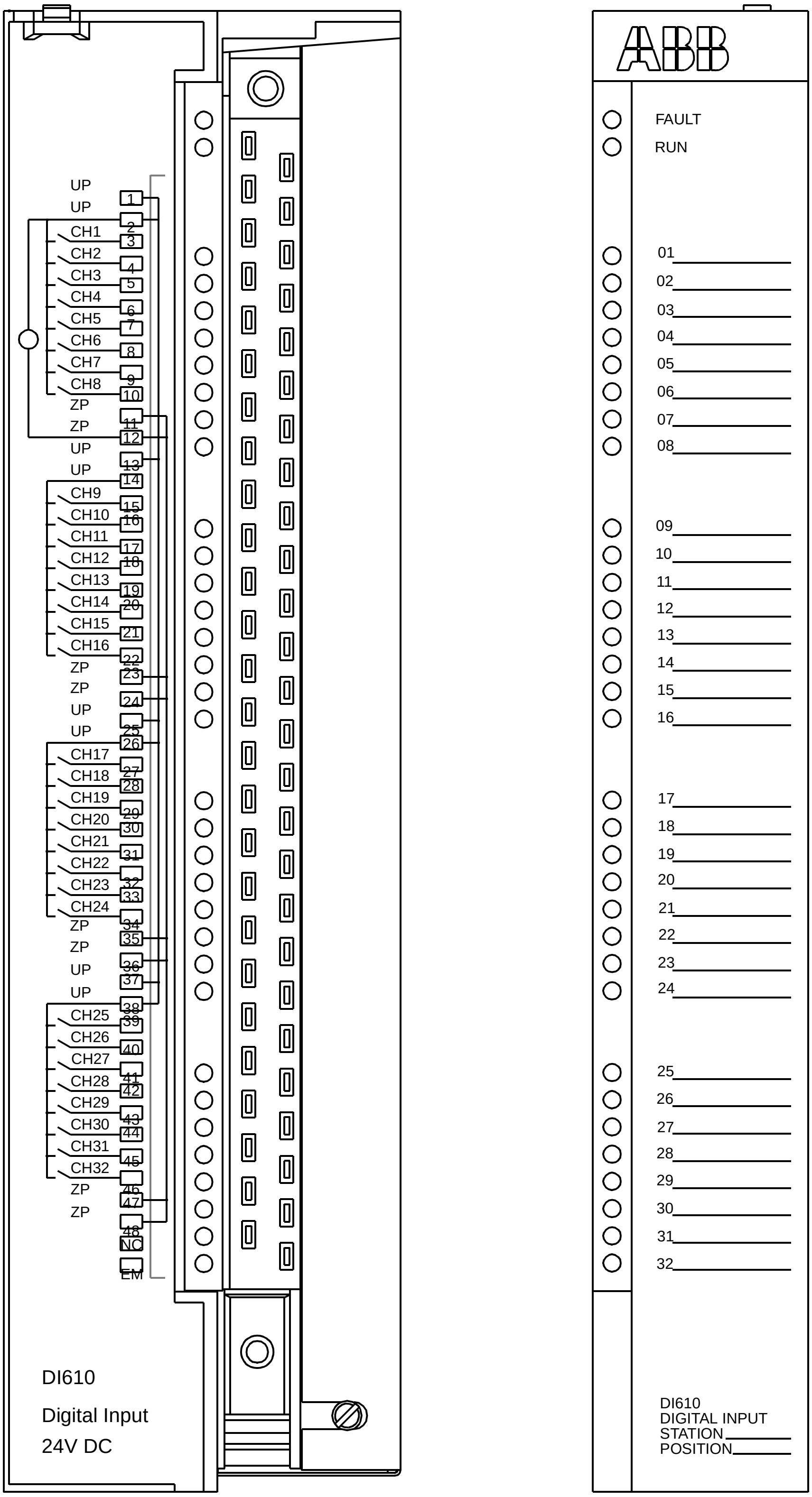


Figure 5-10. Signal Status and Fault Indication on I/O Modules

(7) Checking the Installation

Open-circuits, short-circuits, and loose connections can occur. Therefore, check as necessary:

- External fuses
- Station and PCB connectors
- Wiring, screwed terminals
- Mechanical installation.

(8) Replacement of Defective Modules

Except MVI submodule (CI532) all modules can be replaced during operation while the voltage supply is switched on.
The diagnosis software reconfigures the new module.

Do the following when replacing modules:

- Follow the requirements of Section 5.1.1, Safety Regulations.
- Follow the requirements of Section 5.6.1, Module Replacement.
- Check that the new module is of the correct type.
- Transfer any labels indicating the position, and so on, from the original to the new module.
- Note any symptoms observed and other useful information and attach this information to the module returned for repair.

(9) Restart the Control System

After replacement of the defective modules, restart the control system.

(10) System Restart

If no diagnostic information is available, attempt to restart the system. To restart the system, press the INIT push button, which results in a cold start with the START MODE selector in either the CLEAR or the AUTO position.

(11) Fault Tracing by Interpretation of Fault Symptoms

Refer to Section 5.5, Advanced Fault Tracing.

If the diagnostic information presented is insufficient, contact a suitable service workshop to assist you in interpreting the symptoms or attempt to obtain more details with the aid of the usual service equipment.

(12) Checking Process Functions

- Compare with the original performance to check that the correct action has been taken.
- Check that the original operating parameters, and so on, have not been changed by the fault tracing action.
- Utilize any checklist which may be available on site.

(13) Log Symptoms and Corrective Action or Repairs in Fault Report

Information regarding previous malfunctioning can be of great assistance for subsequent maintenance of the equipment. Keep a record of all faults and corrective action taken.

When contacting ABB support line, be sure to have the release and revision numbers of your software ready.
The release and revision number for the Function Chart Editor (FCB) can be found by clicking **Help | About**.
The release and revision number of the system software of your controller are shown in the options report of the Function Chart Editor (FCB) (**Target | Report Options**).

5.5 Advanced Fault Tracing

Advanced fault tracing is for the detection of errors in application and system software, and when the system does not operate at all, with the help of:

- LEDs on the modules
- The diagnostic display on the processor module
- Error reports using the engineering station
- Fault tracing by interpretation of fault symptoms.

The engineering station should be available in addition to the equipment necessary for basic fault tracing.

Refer to Section 5.2.5, Faults Stopping the System and Section 5.2.6, Faults Not Stopping the System which describes faults indicated by diagnostic display on the processor module and by error report.

5.5.1 Fault Tracing by Interpretation of Fault Symptoms

Follow this procedure to locate module faults, which do not activate the built-in supervision system, and faults in the signal connections and the wiring.

This type of fault tracing assumes knowledge of the process functions and the availability of circuit diagrams and other relevant documents. Follow this procedure:

- Study the fault symptoms and determine the inputs and outputs affected.
- For example, the fault is on a digital input module. The signal status LED on the module lights, but the value in the data base element is not updated. In the case of analog signals, check first that the signal is activated in the data base element.
- Determine whether the fault is in the process equipment or wiring or in the Advant Controller 110. Do this by measuring the input/output signals at the process connector.
- If the fault is found to be in the Advant Controller 110 equipment, attempt to track it in from the process connector to the input/output module and on to the input signal data base element. If the signal is an output signal, the fault is traced in the opposite direction. It should be possible to locate the fault following this procedure.

5.6 User Repair

5.6.1 Module Replacement

5.6.1.1 General

User support for maintenance (and especially for module replacement) has been designed into the Advant Controller 110. The system supports you to replace or insert a module during operation.

The system has the following important built-in hardware and software measures designed to cope with the special situation of module replacement:

- When the process connector is removed, the system registers this, error signals are set on DB elements and updating of the "VALUES" is discontinued. Operation of the module is inhibited (the green LED RUN extinguishes) and the outputs are switched off.
- Precautions have been taken (for example, leading ground pins on the bus connectors, and so on) to ensure that whenever a module is withdrawn or inserted, the rest of the system is not disturbed.
- Before an exchanged module can go into operation again, the process connector must be inserted and the diagnostic checks must all be satisfactory. The diagnostic checks include type of module and position (slot).

WARNING

> Before replacing a module in a running system, it is important that you examine the consequences. Process equipment may be damaged if critical signals are not updated.

For this reason, it is essential that you know which signals are affected. For example:

- The replacement of an I/O module affects all channels on the module.
- The replacement of a bus extender (for example, CI610) affects the whole I/O station.

Fully consider and understand the consequences before taking any action.

5.6.1.2 Replacement of an I/O Module

The system software in the Advant Controller 110 automatically checks that all I/O modules are operating correctly. In the event of a defective or missing module (for example, during replacement), the module and associated signals are flagged at the "ERR" terminal of the data base elements. The signal value (VALUE) is not updated as long as the error persists.

The I/O module runs a self-testing routine following power-up and during operation. Providing no serious defect is detected, the red LED (FAULT) extinguishes. The system software checks that:

- The module is in the correct position (position).
- The module is of the right type.
- The module is not defective.
- The process connector is in place.

If all these points are in order, the green LED (RUN) lights up, the error flag on the data base element is reset, and the module switches to the operating mode.

Before replacing output modules (analog or digital), it is advisable to isolate the output signals from the process.

Follow this procedure to replace a faulty or suspect I/O module:

1. Read Section 5.1.1, Safety Regulations.
2. Open the front door of the module. Remove the paper strip (with the signal names) inside the front door to use again with the new module.
3. Release the screw securing the process connector (about 15 turns) until it turns freely. If the module is in operation, it registers that the connector has been removed and stops operating (green LED RUN extinguishes).
4. Remove the process connector.
5. Release the screw securing the module (about 15 turns) until it turns freely and withdraw the module.
6. Check that the new module is the same type as the old one.
7. Insert the new module. Ensure that it is fully in place up to the hinge of the subrack. Tighten the module-securing screw. If the module is working correctly, the red LED (FAULT) lights briefly and then extinguishes.
8. Insert the process connector and tighten the connector screw. The new module is taken into operation automatically and the green LED (RUN) lights up.
9. Exchange the paper strip and close the front door.

5.6.1.3 Replacement of a Bus Extender

Removing the bus extender CI615 during operation is NOT allowed.

You can replace the bus extenders CI610 during operation. Removing a bus extender CI610 (in an I/O station) only affects that particular I/O station.

As soon as the bus extension cable TK610 is disconnected, communication is interrupted and all outputs—analog and digital—immediately assume "zero" state. The green LED (RUN) remains lit. The "zero" state is the safe position and is defined as follows.

For digital outputs: off state, for example, relays open.
For analog outputs: 0 V or 0 mA.

Follow this procedure to replace a faulty or suspect bus extender CI610:

1. Read Section 5.1.1, Safety Regulations.
2. Open the front door of the bus extender and release the two screws on the bus connector.
3. Remove the bus connector. If more than one I/O station is connected, remove both connectors together, being careful not to disrupt the bus. The LED (TRANSFER) on the bus extender concerned extinguishes and all outputs of associated stations assume the "zero" state.
4. Release the screw securing the module until it turns freely and withdraw the module.

5. Check that the new module is of the same type as the old one.
6. Insert the new module. Ensure that it is fully in place up to the hinge of the subrack. Tighten the module-securing screw. If the module is working correctly, the red LED (FAULT) lights briefly and then extinguishes.
7. Insert the bus connector and tighten the connector-securing screws. The new module starts to operate automatically and the green LED (RUN) and the LED (TRANSFER) light up. The outputs resume normal operation.
8. Close the front door.

5.6.1.4 Replacement of AF 100 Communication Interface

You can replace the Advant Fieldbus 100 communication interface during operation. The extent to which communication is affected depends on the particular configuration (for example, redundant bus lines) and on the kind of fault.

In the case of redundant bus lines, a bus cable can be replaced with no effect on system operation. As long as the bus cable is disconnected, communication runs on the remaining bus line.

In the case of a disconnected communication interface CI626/CI627, the bus goes on operating and communication between other stations is unaffected. The new unconfigured communication interface is configured and starts to operate automatically.

Refer to the *Advant Fieldbus 100 User's Guide* for further details.

5.6.1.5 Replacement of a Processor Module

In the event a processor module must be replaced, you must take the system out of service.

The application program must be loaded in the new processor module and the system must be restarted. This requires an engineering station tool and detailed knowledge of how to load and restart the system.

Refer to *Advant Station 100 Series Engineering Station User's Guide* for details.

5.6.1.6 Replacement of a Battery Module SB610 or SB611

You can replace the battery module SB610 or SB611 on the processor module during operation. The procedure is as follows:

1. Open the front door of the processor module.
2. Release the screws and take out the old SB610 or SB611 module. Note that the LED (UBatt) extinguishes, if it is not already off.
3. Insert the new battery module and tighten the screws. The LED (UBatt) lights up again.

NOTE

If the power is off when you withdraw the battery module, the contents of the RAM and timer data are lost, that is, the values of backup variables are undefined and a "warm start" is no longer possible.

5.6.1.7 Replacement of a Power Supply Module SA610

When you replace a power supply module SA610, it is safer to switch off the central mains supply (AC/DC) feeding SA610. This does not necessarily mean that you must switch off the complete AC 110.

NOTE

> If the power supply module is in an I/O station, then you need only switch off this station (if this is not already the case). The rest of the system can remain in operation.

Follow this procedure to replace a faulty or suspect power supply module SA610:

1. Switch off mains supply to the power supply module.
2. Open the front door of the module and check that the mains voltage is off. The LED (Uin) must not be lit.
3. Release the screws on the mains connector "INPUT" and the indication connector "OUTPUT ANNUNCIATOR" and remove both connectors.
4. Release the screw securing the module until it turns freely and withdraw the power supply module from the subrack.
5. Check that the jumpers (USA, USB) on the new module are in the correct positions (same positions as on the old unit). For more information on these two jumpers, see Section 4.2, Operating Instructions.
6. Insert the new module and tighten the module-securing screw. Fit the mains cable and the indication cable and tighten their securing screws.
7. Switch on the mains supply (LED U_{in} lights up) and switch on the power supply module (I/O switch). If the module is operating correctly, the green LED (RUN) lights up and the red LED (FAULT) stays dark.

5.7 Calibration of Analog Input and Outputs

During the course of manufacture, all measurement and output ranges of analog I/O modules are calibrated at an ambient temperature of 25°C. Normally, the modules need no further calibration.

Should you find, however, that the accuracy is outside the specified limits (for example, due to component failure), send the module to ABB Process Automation for repair. You cannot recalibrate these units yourself.

The analog modules are designed in such a way that component aging has little affect on specified accuracy. This is the result of:

- Use of high-quality, low-drift components. For example, the analog circuits do not include any potentiometers (which are often the cause of drift problems).
- Use of self-calibration techniques in modules of high-specified accuracy (high-end modules). The self-calibration techniques are based on high-precision resistors and on voltage sources with extremely low drift due to temperature and aging.

See *S600 I/O Hardware Reference Manual* for accuracy of individual analog I/O modules.

Appendix A Hardware Components

A.1 Hardware Components Listed in Alphabetical Order

The list below contain a complete list of all types of hardware components related to the Advant Controller 110 and S600 I/O. They are listed in alphabetical order.

A reference is given telling you where to find a module description, including important technical data:

- AC110 refers to this manual, *Advant Controller 110 User’s Guide*
- S600 refers to *S600 I/O Hardware Reference Manual*
- MasterFieldbus refers to *MasterFieldbus and S400 I/O*.

Table A-1. Hardware Components Listed in Alphabetical Order

Type	Denomination	Reference to Description
AI610	Analog input module	S600
AI620	Analog input module	S600
AI625	Analog input module	S600
AI630	Analog input module	S600
AI635	Analog input module	S600
AO610	Analog output module	S600
AO650	Analog output module	S600
CI532V01	RCOM communication submodule	RCOM AC 110
CI532V02	MODBUS communication submodule	MultiVendor Interface MODBUS AC 110
CI532V03	Siemens 3964R communication submodule	MultiVendor Interface Siemens 3964R AC 110
CI610	Bus extender module for I/O station	S600
CI615	Bus extender module for base station	S600
CI626V01	AF 100 communication module (coax cable)	S600
CI627	AF 100 communication module (twisted pair)	S600
CI670	MasterFieldbus communication module (slave)	S600

Table A-1. Hardware Components Listed in Alphabetical Order (Continued)

Type	**Denomination**	**Reference to Description**
CI671	MasterFieldbus communication module (master)	S600
DI610	Digital input module	S600
DI620	Digital input module	S600
DI621	Digital input module	S600
DI622	Digital input module	S600
DI635	Digital input module	S600
DI636	Digital input module	S600
DI650	Digital input module	S600
DI651	Digital input module	S600
DI652	Digital input module	S600
DO610	Digital output module	S600
DO620	Digital output module	S600
DO625	Digital output module	S600
DO630	Digital output module	S600
DP620	Pulse counter module	S600
DSTC 404	Powered terminator for MasterFieldbus SDB	MasterFieldbus
DSTC 406	Passive terminator for MasterFieldbus SDB	MasterFieldbus
DSTC 451	Overvoltage protector for MasterFieldbus	MasterFieldbus
DSTC 452	Modem for MasterFieldbus coax link (LDB)	MasterFieldbus
DSTC 454L	Modem for MasterFieldbus optical link (LDB)	MasterFieldbus
DSTC 456	Multiplexer for redundant MasterFieldbus	MasterFieldbus
PM632	Processor module	AC110
PM633	Processor module	AC110
PM634	Processor module	AC110
RB601	Dummy module	S600
RC610	Cable duct	S600
RC620	Fan unit	S600
RF615	Basic subrack	S600
RF620	Extension subrack	S600

Table A-1. Hardware Components Listed in Alphabetical Order (Continued)

Type	Denomination	Reference to Description
SA610	Power supply module	S600
SA161	Power supply	AC110
SA162	Power supply	AC110
SA171	Power supply for field devices	AC110
SA172	Power supply for field devices	AC110
SB610	Lithium battery for PM632	AC110
SB611	Battery for PM633 and PM634	AC110
SC610	Submodule carrier	S600
SX540	Power switch and distribution unit	AC110
SX542	Power distribution unit	AC110
SX554	Distribution unit 60 V d.c.	AC110
TC610	Terminator for bus extension	S600
TC630	Modem for Advant Fieldbus 100 optical link	Advant Fieldbus 100
TC670	Passive terminator for MasterFieldbus SDB	S600
TF620	Front connector for I/O modules	S600
TK610	Bus extension cable	S600
TK612	Bus cable	S600
TK615	Station voltage cable	S600
TK630	Process cable with front connector	S600
TK640	Screened process cable with front connector	S600

A.2 Hardware Components Listed in Functional Order

The list below contain a complete list of all types of hardware components related to the Advant Controller 110 and S600 I/O. They are listed in functional order.

A reference is given telling you where to find a module description, including important technical data:

- AC110 refers to this manual, *Advant Controller 110 User's Guide*
- S600 refers to *S600 I/O Hardware Reference Manual*
- MasterFieldbus refers to *MasterFieldbus and S400 I/O.*

Table A-2. Hardware Components Listed in Functional Order

Type	Denomination	Reference to Description
Analog input modules		
AI610	Analog input module	S600
AI620	Analog input module	S600
AI625	Analog input module	S600
AI630	Analog input module	S600
AI635	Analog input module	S600
Analog output modules		
AO610	Analog output module	S600
AO650	Analog output module	S600
Digital input modules		
DI610	Digital input module	S600
DI620	Digital input module	S600
DI621	Digital input module	S600
DI622	Digital input module	S600
DI635	Digital input module	S600
DI636	Digital input module	S600
DI650	Digital input module	S600
DI651	Digital input module	S600
DI652	Digital input module	S600
DO610	Digital output module	S600
Digital output modules and pulse counter modules		
DO620	Digital output module	S600
DO625	Digital output module	S600
DO630	Digital output module	S600
DP620	Pulse counter module	S600
Processor modules		
PM632	Processor module	AC110
PM633	Processor module	AC110

Table A-2. Hardware Components Listed in Functional Order (Continued)

Type	Denomination	Reference to Description
PM634	Processor module	AC110
Communication (modules, cables, terminators, and so on)		
TK612	Bus cable	S600
CI610	Bus extender module for I/O station	S600
CI615	Bus extender module for base station	S600
TK610	Bus extension cable	S600
TC610	Terminator for bus extension	S600
CI626V01	AF 100 communication module (coax cable)	S600
CI627	AF 100 communication module (twisted pair)	S600
TC630	Modem for Advant Fieldbus 100 optical link	Advant Fieldbus 100
CI670	MasterFieldbus communication module (slave)	S600
TC670	Passive terminator for MasterFieldbus SDB	S600
CI671	MasterFieldbus communication module (master)	S600
DSTC 404	Powered terminator for MasterFieldbus SDB	MasterFieldbus
DSTC 406	Passive terminator for MasterFieldbus SDB	MasterFieldbus
DSTC 451	Overvoltage protector for MasterFieldbus	MasterFieldbus
DSTC 456	Multiplexer for redundant MasterFieldbus	MasterFieldbus
DSTC 452	Modem for MasterFieldbus coax link (LDB)	MasterFieldbus
DSTC 454L	Modem for MasterFieldbus optical link (LDB)	MasterFieldbus
SC610	Submodule carrier	S600
CI532V01	RCOM communication submodule	RCOM AC 110
CI532V02	MODBUS communication submodule	MultiVendor Interface MODBUS AC 110
CI532V03	Siemens 3964R communication submodule	MultiVendor Interface Siemens 3964R AC 110
Power supply (modules, distribution units, cables, and so on)		
SA610	Power supply module	S600
SA161	Power supply	AC110

Table A-2. Hardware Components Listed in Functional Order (Continued)

Type	Denomination	Reference to Description
SA162	Power supply	AC110
SA171	Power supply for field devices	AC110
SA172	Power supply for field devices	AC110
SX540	Power switch and distribution unit	AC110
SX542	Power distribution unit	AC110
SX554	Distribution unit 60 V d.c.	AC110
TK615	Station voltage cable	S600
SB610	Lithium battery for PM632	AC110
SB611	Battery for PM633 and PM634	AC110
Other components		
RF615	Basic subrack	S600
RF620	Extension subrack	S600
RC610	Cable duct	S600
RC620	Fan unit	S600
TF620	Front connector for I/O modules	S600
TK630	Process cable with front connector	S600
TK640	Screened process cable with front connector	S600
RB601	Dummy module	S600

Appendix B Processor Modules and Backup Battery

B.1 PM632

Summary

The processor module PM632 is the module on which the CPU (central processing unit) of the Advant Controller 110 is located. It is based on a high-performance 16-/32-bit Motorola microprocessor. The system software is stored in Flash-EPROM on the processor module.

The Advant Controller 110 system software includes a real-time operating system, a PC element library, diagnostic functions and interfaces for the Advant Engineering Station 100 Series and an operator station.

The application program is stored in a nonvolatile memory in the processor module. At power-up, the application program is transferred from the nonvolatile memory and runs from RAM.

Module Replacement

PM632 can be replaced under voltage, but of cause this Advant Controller 110 has to be restarted after replacement.

Technical Data

Table B-1. PM632 Technical Data

Processor Module	**PM632**
Processor	Motorola 68HC000/ 16 MHz
Memory	64 kbytes boot EPROM 256 kbytes Flash EPROM for system software 256 kbytes Flash EPROM for application programs 512 kbytes RAM for application and system purposes
Realtime clock	Built in for time and calendar functions
Interfaces	2 RS 232C opto-isolated serial interfaces
Interface connector 1	CH 1: female 9-pin D-sub connector Pin 2 - TxD Pin 3 - RxD Pin 5 - GND Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Interface connector 2	CH 2: female 9-pin D-sub connector Pin 1 - DCD Pin 2 - TxD Pin 3 - RxD Pin 4 - DTR Pin 5 - GND Pin 6 - DSR Pin 7 - RTS Pin 8 - CTS Pin 9 - RI Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Power dissipation	< 10 W
Relay contact	
Max. voltage	48 V DC
Max. current	0.5 A
Max. DC switching power	10 W
Relay connector	4-pin connector Pin 2 - Common Pin 1 - Normally closed when CPU in op. mode Pin 3 - Normally open when CPU in op. mode
Relay plug with cable	3BHT 310359R1 3x1 mm^2, 3 m length
Lithium battery	Plug-in unit, backup of RWM, realtime clock and calendar. Backup time 20 weeks.

Front View

All the following elements are located on the front of the module:

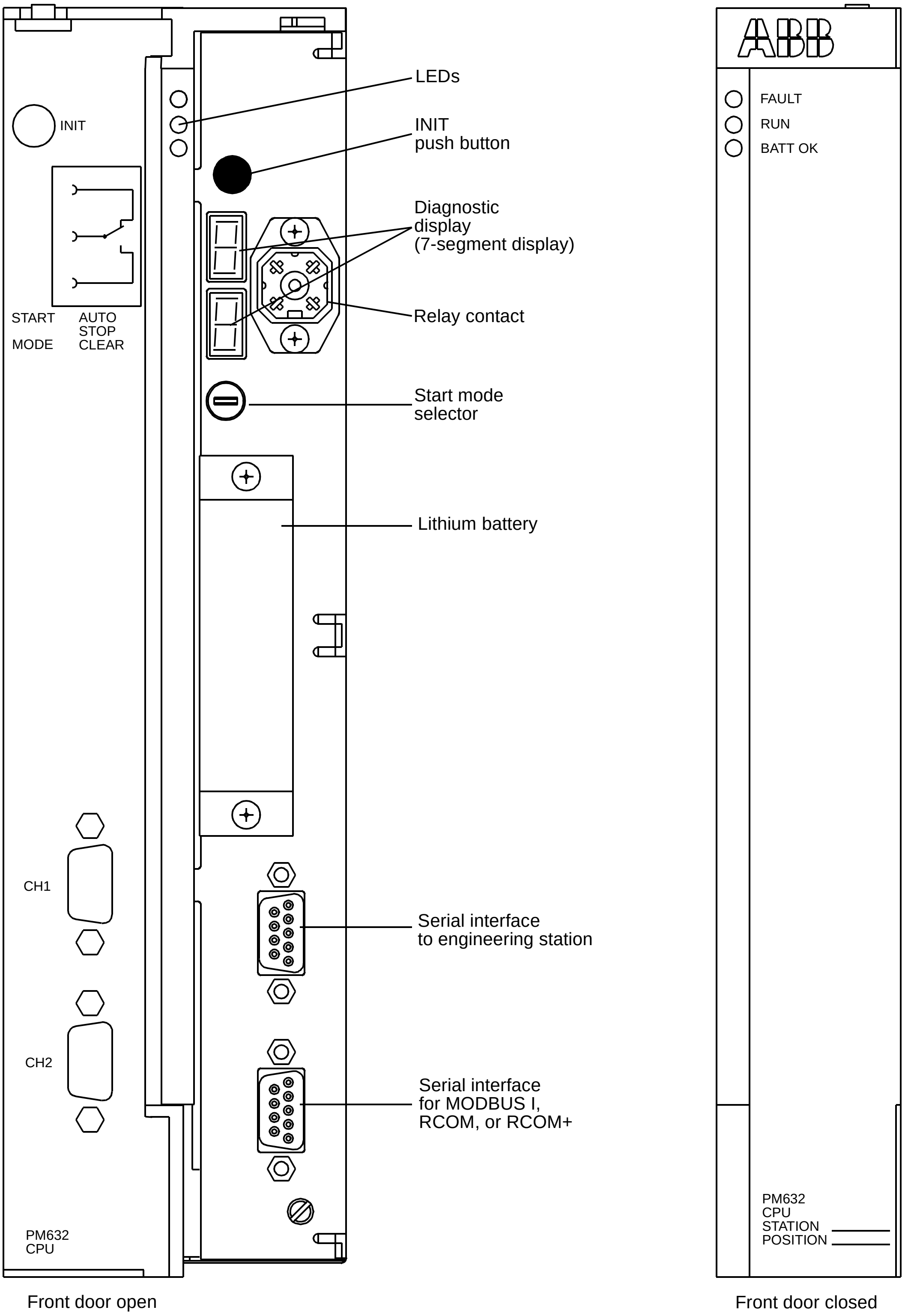


Figure B-1. PM632 Front View

Functional Description

The processor module PM632 is housed in the same enclosure as the I/O modules. No external memory is needed; the processor module already contains the required RAM and FPROM. The PM632 must be placed in position 1 (that is, position number 1 in the basic subrack) of the base station.

The PM632 is based on a 16-bit Motorola 68HC000 processor. The system software includes diagnostic routines which check the CPU and the system during initialization and ensure system integrity during the execution of the application program.

The application program is stored in a Flash EPROM. The code of the application is basically held in 256 kilobytes. The application runs from a RAM copy of the Flash EPROM.

During power-up, the functions of the processor and the contents of application and system Flash-EPROM are checked as well as the internal RAM. While the application program is running, the diagnostic routines continue checking operation without delaying or influencing the execution.

Indication of Module Status

Three LEDs and a diagnostic display indicate the status of the module. The LEDs at the front side are always visible, the diagnostic display only with the front door opened.

LED-Status Indication

R(un) LED

The Run LED is green and indicates that the CPU is up and running.

F(ault) LED

The Fault LED is red and indicates a fault condition on the processor module.

B(attery) LED

The Bat LED is green and indicates that the battery backup voltage is ok.
This function is always enabled, independent of the setting of the attribute WITH_BAT of the DB element for PM632, which only enables or disables error report entries for battery supervision.

Status Indication of the Diagnostic Display

The diagnostic display indicates the processor module operating mode:

P- = start-up

P1 = normal operation

P3 = stop after initialization

P4 = CPU is not running an application

P5 = loading application program from PROM

P6 = engineering station is connected and is in the on-line mode

PL = waiting for download of system software

PU = loading system software option (enabling options)

xx = error code.

If a two-digit number (xx) is visible, the system has stopped and the number represents an error code.

Characteristics of Connections

PM632 is connected to the process via the backplane I/O-bus (BIOB) and the I/O-modules.

Besides that there are some connections at the front side:

- Serial interface connections
  - Front connector CH1 to connect an Advant Engineering Station 100 Series. Communication speed is fixed at 9600 bit/sec.
  - Front connector CH2 for exchanging data using the optional Modbus I protocol, RCOM, or RCOM+.
- Lithium battery
  The lithium battery (SB610) is used to back up the internal RAM of the CPU and the calendar chip.
- Relay contact
  In the case of a system shutdown, the relay contact is switched automatically.

INIT Push Button and START MODE SELECTOR

INIT

Pressing the INIT push button initiates a CPU cold start.

START MODE

The START MODE selector has three positions which influence the power-up and restart behavior of the CPU. If possible, a restart is made automatically after an error is detected.

- CLEAR - cold start
  The initialization procedure starts from the beginning and hardware and software are reset to their initial states. Application software is loaded from the internal PROM into the RAM. The cold start procedure is executed after power-up and after pressing the INIT push button.
- AUTO - warm start
  The system software attempts to restart the application program after an error occurs, and in doing so, checks the integrity of the application program loaded. If a restart is possible, the system software continues executing the application program. If the application program is corrupted, a cold start is executed.
- STOP
  The user can prevent the application program from starting if the start mode selector is in the stop position. The system software continues execution to allow access to the stored error messages using the Advant Station Series 100ES.

B.2 PM633

Summary

The processor module PM633 is the module on which the CPU (central processing unit) of the Advant Controller 110 is located. It is based on a high-performance 16-/32-bit Motorola microprocessor. The system software is stored in Flash-EPROM on the processor module.

The Advant Controller 110 system software includes a real-time operating system, a PC element library, diagnostic functions and interfaces for the Advant Engineering Station 100 Series and an operator station.

The application program is stored in a nonvolatile memory in the processor module. At power-up, the application program is transferred from the nonvolatile memory and runs from RAM.

Module Replacement

PM633 can be replaced under voltage, but of cause this Advant Controller 110 has to be restarted after replacement.

Technical Data

Table B-2. PM633 Technical Data

Processor Module	PM633
Processor	Motorola MC68340, 25 MHz
Memory	1 MB static System-RAM with battery back-up 1 MB system software Flash-EPROM 1 MB User Flash-EPROM
Realtime clock	Built in for time and calendar functions
Interfaces	2 RS 232C opto-isolated serial interfaces
Interface connector 1	CH 1: female 9-pin D-sub connector Pin 2 - TxD Pin 3 - RxD Pin 5 - GND Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Interface connector 2	CH 2: male 9-pin D-sub connector Pin 1 - DCD Pin 2 - RxD Pin 3 - TxD Pin 4 - DTR Pin 5 - GND Pin 6 - DSR Pin 7 - RTS Pin 8 - CTS Pin 9 - RI Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Power dissipation	< 20 W
Relay contact	
Max. voltage	48 V DC
Max. current	0.5 A
Max. DC switching power	10 W
Relay connector	3-pin connector Pin 1- Normally open when CPU in op. mode Pin 2- Normally closed when CPU in op. mode Pin 3 - Common signal
Sync input	24 V/10 mA, isolated Pin 1 - Synchronization input Pin 2 - Signal ground
Back-up	Backup of SRAM and Real Time Clock. Backup time 20 weeks.

Front View

All the following elements are located on the front of the module:

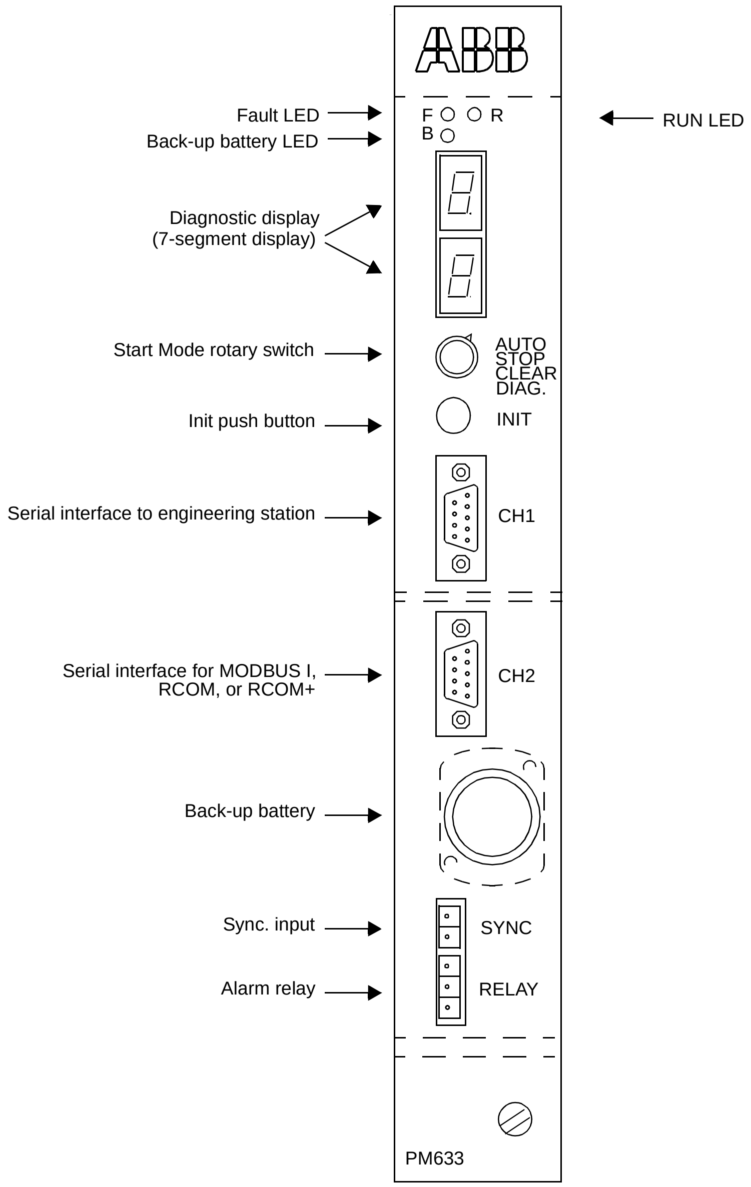


Figure B-2. PM633 Front View

Functional Description

The processor module PM633 is housed in the same enclosure as the I/O modules. No external memory is needed; the processor module already contains the required RAM and FPROM.
The PM633 must be placed in position 1 (that is, position number 1 in the basic subrack) of the base station.

The PM633 is based on a 32-bit Motorola MC68340 processor. The system software includes diagnostic routines which check the CPU and the system during initialization and ensure system integrity during the execution of the application program.

The application program is stored in a Flash EPROM. The application runs from a RAM copy of the Flash EPROM.

During power-up, the functions of the processor and the contents of application and system Flash-EPROM are checked as well as the internal RAM. While the application program is running, the diagnostic routines continue checking operation without delaying or influencing the execution.

Indication of Module Status

Three LEDs and a diagnostic display indicate the status of the module. The LEDs at the front side are always visible, the diagnostic display only with the front door opened.

LED-Status Indication

R(un) LED

The Run LED is green and indicates that the CPU is up and running.

F(ault) LED

The Fault LED is red and indicates a fault condition on the processor module.

B(attery) LED

The Bat LED is green and indicates that the battery backup voltage is ok.
This function is always enabled, independent of the setting of the attribute WITH_BAT of the DB element for PM633, which only enables or disables error report entries for battery supervision.

Status Indication of the Diagnostic Display

The diagnostic display indicates the processor module operating mode:

P- = start-up

P1 = normal operation

P3 = stop after initialization

P4 = CPU is not running an application

P5 = loading application program from PROM

P6 = engineering station is connected and is in the on-line mode

PL = waiting for download of system software

PU = loading system software option (enabling options)

xx = error code.

If a two-digit number (xx) is visible, the system has stopped and the number represents an error code.

Characteristics of Connections

PM633 is connected to the process via the backplane I/O-bus (BIOB) and the I/O-modules.

Besides that there are some connections at the front side:

- Serial interface connections
  - Front connector CH1 to connect an Advant Engineering Station 100 Series. Communication speed is fixed at 9600 bit/sec.
  - Front connector CH2 for exchanging data using the optional Modbus I protocol, RCOM, or RCOM+.
- Battery
  The lithium battery is used to back up the internal RAM of the CPU and the calendar chip.
- Relay contact
  In the case of a system shutdown, the relay contact is switched automatically.
- SYNC input
  The SYNC input is used for external time synchronization.

INIT Push Button and START MODE SELECTOR

INIT

Pressing the INIT push button initiates a CPU cold start.

START MODE

The START MODE selector has three positions which influence the power-up and restart behavior of the CPU. If possible, a restart is made automatically after an error is detected.

- CLEAR - cold start
  The initialization procedure starts from the beginning and hardware and software are reset to their initial states. Application software is loaded from the internal PROM into the RAM. The cold start procedure is executed after power-up and after pressing the INIT push button.
- AUTO - warm start
  The system software attempts to restart the application program after an error occurs, and in doing so, checks the integrity of the application program loaded. If a restart is possible, the system software continues executing the application program. If the application program is corrupted, a cold start is executed.
- STOP
  The user can prevent the application program from starting if the start mode selector is in the stop position. The system software continues execution to allow access to the stored error messages using the Advant Station Series 100ES.

- DIAG
  The PM633 has an additional switch position. When started with the switch in position DIAG, it only performs the initial processor diagnostics. The results are shown on the processor module diagnostic display.
  To restart the processor module again, put the switch in one of the other positions and press INIT.

B.3 PM634

Summary

The processor module PM634 is the module on which the CPU (central processing unit) of the Advant Controller 110 is located. It is based on a high-performance 16-/32-bit Motorola microprocessor.
It features a build-in PROFIBUS-DP interface that conforms to EN 50 170.
The system software is stored in Flash-EPROM on the processor module.

The Advant Controller 110 system software includes a real-time operating system, a PC element library, diagnostic functions and interfaces for the Advant Engineering Station 100 Series and an operator station.

The application program is stored in a nonvolatile memory in the processor module. At power-up, the application program is transferred from the nonvolatile memory and runs from RAM.

PM634 needs two positions in the subrack.

Module Replacement

PM634 can be replaced under voltage, but of cause this Advant Controller 110 has to be restarted after replacement.

Technical Data

Table B-3. PM634 Technical Data

Processor Module	PM634
Processor	Motorola MC68340, 25 MHz
Memory	1 MB static System-RAM with battery back-up 1 MB system software Flash-EPROM 1 MB User Flash-EPROM
Realtime clock	Built in for time and calendar functions
Interfaces	2 RS 232C opto-isolated serial interfaces
Interface connector 1	CH 1: female 9-pin D-sub connector Pin 2 - TxD Pin 3 - RxD Pin 5 - GND Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Interface connector 2	CH 2: male 9-pin D-sub connector Pin 1 - DCD Pin 2 - RxD Pin 3 - TxD Pin 4 - DTR Pin 5 - GND Pin 6 - DSR Pin 7 - RTS Pin 8 - CTS Pin 9 - RI Transmission line isolated via opto couplers, common 5V, galvanically isolated against CPU supply
Interface connector 3	CH3: female 9-pin D-sub connector Pin 1 - Ground Pin 2 - M24 Pin 3 - RxD / TxD-P Pin 4 - CNTR-P Pin 5 - DGND Pin 6 - VP Pin 7 - P24 Pin 8 - RxD / TxD-N Pin 9 - CNTR-N Connector for the PROFIBUS-DP line

Table B-3. PM634 Technical Data

Processor Module	**PM634**
Interface connector 4	CH3: female 9-pin D-sub connector Pin 1 - Ground Pin 2 - M24 Pin 3 - RxD / TxD-P Pin 4 - CNTR-P Pin 5 - DGND Pin 6 - VP Pin 7 - P24 Pin 8 - RxD / TxD-N Pin 9 - CNTR-N Connector for the PROFIBUS-DP line (currently not used)
Power dissipation	< 20 W
Relay contact	
Max. voltage	48 V DC
Max. current	0.5 A
Max. DC switching power	10 W
Relay connector	3-pin connector Pin 1 - Normally open when CPU in op. mode Pin 2 - Normally closed when CPU in op. mode Pin 3 - Common signal
Sync input	24 V/10 mA, isolated Pin 1 - Synchronization input Pin 2 - Signal ground
Back-up	Backup of SRAM and Real Time Clock. Backup time 20 weeks.

Front View

All the following elements are located on the front of the module:

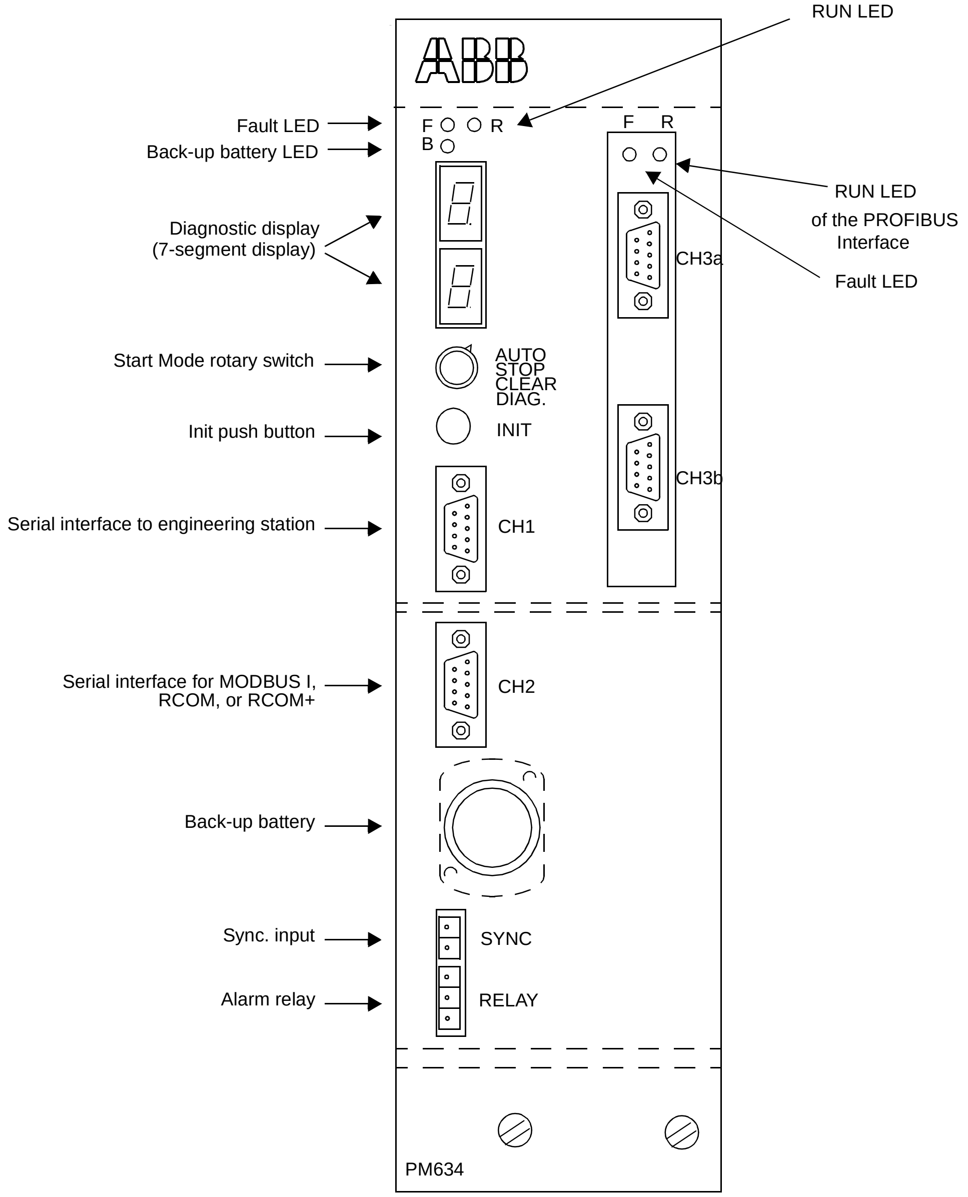


Figure B-3. PM634 Front View

Functional Description

The processor module PM634 is housed in the same enclosure as the I/O modules. No external memory is needed; the processor module already contains the required RAM and FPROM. The PM634 must be placed in position 1 (that is, position number 1 in the basic subrack) of the base station.

The PM634 is based on a 32-bit Motorola MC68340 processor. The system software includes diagnostic routines which check the CPU and the system during initialization and ensure system integrity during the execution of the application program.

The application program is stored in a Flash EPROM. The application runs from a RAM copy of the Flash EPROM.

During power-up, the functions of the processor and the contents of application and system Flash-EPROM are checked as well as the internal RAM. While the application program is running, the diagnostic routines continue checking operation without delaying or influencing the execution.

Indication of Module Status

Three LEDs and a diagnostic display indicate the status of the module. The LEDs at the front side are always visible, the diagnostic display only with the front door opened.

LED-Status Indication

R(un) LED

The Run LED is green and indicates that the CPU is up and running.

F(ault) LED

The Fault LED is red and indicates a fault condition on the processor module.

B(attery) LED

The Bat LED is green and indicates that the battery backup voltage is ok.
This function is always enabled, independent of the setting of the attribute WITH_BAT of the DB element for PM634, which only enables or disables error report entries for battery supervision.

Status Indication of the Diagnostic Display

The diagnostic display indicates the processor module operating mode:

P- = start-up

P1 = normal operation

P3 = stop after initialization

P4 = CPU is not running an application

P5 = loading application program from PROM

P6 = engineering station is connected and is in the on-line mode

PL = waiting for download of system software

PU = loading system software option (enabling options)

xx = error code.

If a two-digit number (xx) is visible, the system has stopped and the number represents an error code.

Characteristics of Connections

PM634 is connected to the process via the backplane I/O-bus (BIOB) and the I/O-modules. Besides that there are some connections at the front side:

- Serial interface connections
  - Front connector CH1 to connect an Advant Engineering Station 100 Series. Communication speed is fixed at 9600 bit/sec.
  - Front connector CH2 for exchanging data using the optional Modbus I protocol, RCOM, or RCOM+.
  - Front connector CH3a, CH3b to connect a PROFIBUS-DP bus line.
- Battery
  The lithium battery is used to back up the internal RAM of the CPU and the calendar chip.
- Relay contact
  In the case of a system shutdown, the relay contact is switched automatically.
- SYNC input
  The SYNC input is used for external time synchronization.

INIT Push Button and START MODE SELECTOR

INIT

Pressing the INIT push button initiates a CPU cold start.

START MODE

The START MODE selector has three positions which influence the power-up and restart behavior of the CPU. If possible, a restart is made automatically after an error is detected.

- CLEAR - cold start
  The initialization procedure starts from the beginning and hardware and software are reset to their initial states. Application software is loaded from the internal PROM into the RAM. The cold start procedure is executed after power-up and after pressing the INIT push button.
- AUTO - warm start
  The system software attempts to restart the application program after an error occurs, and in doing so, checks the integrity of the application program loaded. If a restart is possible, the system software continues executing the application program. If the application program is corrupted, a cold start is executed.
- STOP
  The user can prevent the application program from starting if the start mode selector is in the stop position. The system software continues execution to allow access to the stored error messages using the Advant Station Series 100ES.

- DIAG
  The PM634 has an additional switch position. When started with the switch in position DIAG, it only performs the initial processor diagnostics. The results are shown on the processor module diagnostic display.
  To restart the processor module again, put the switch in one of the other positions and press INIT.

B.4 Backup Batteries for Processor Modules

Table B-4. Backup Batteries

Processor Module	Battery Type	Description
PM632	SB610	This battery has to be mounted at the front of PM632. The lithium battery is used for RAM and real time clock back up. The backup time is 20 weeks. The battery can be replaced without affecting the real time clock or RAM if the system power is applied.
PM633	SB611	This battery has to be inserted in the front of PM633. The lithium battery is used for RAM and real time clock back up. The backup time is 20 weeks. The battery can be replaced without affecting the real time clock or RAM if the system power is applied.
PM634	SB611	This battery has to be inserted in the front of PM634. The lithium battery is used for RAM and real time clock back up. The backup time is 20 weeks. The battery can be replaced without affecting the real time clock or RAM if the system power is applied.

Appendix C Cabinet Configuration

C.1 Single Cabinet Configuration

The figure below shows two single cabinet configurations depending on kind of power supply. You can use power supply unit SA610 or SA161 (input AC 120 V) / SA162 (input AC 230 V).

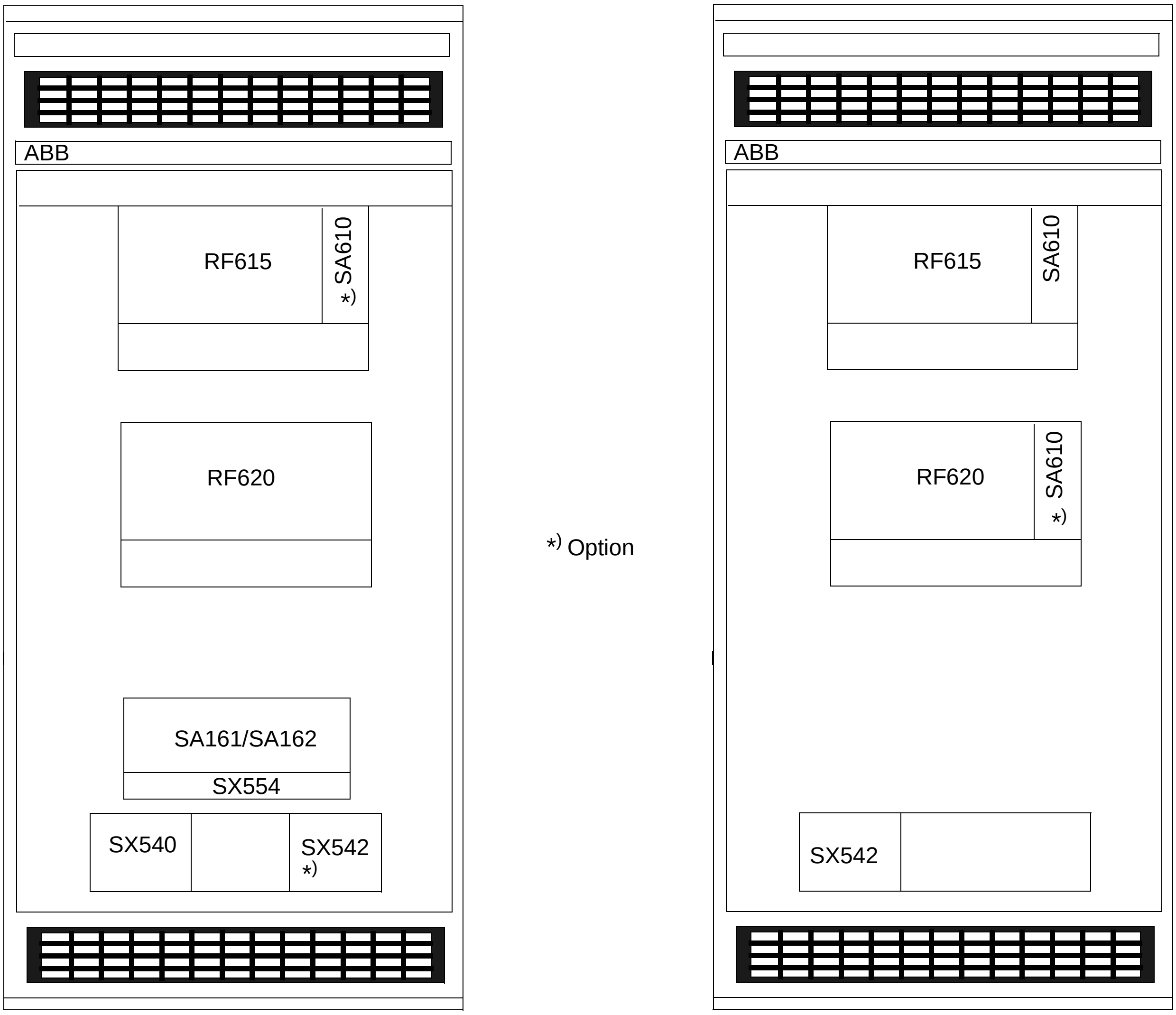


Figure C-1. Single Cabinet Configuration with Different Kinds of Power Supply

See Section C.3, Power Supply Units SA16x and SA17x for technical data of SA16x and Section C.4, Distribution Units for Cabinets for description of distribution units SX540, SX542, and SX554.

For information about SA610, see *S600 I/O Hardware Reference Manual*.

C.2 Maximum Cabinet Configuration

The figure below shows a block diagram of a maximum cabinet configuration using a central power supply unit SA161 (input AC 120 V) or SA162 (input AC 230 V).

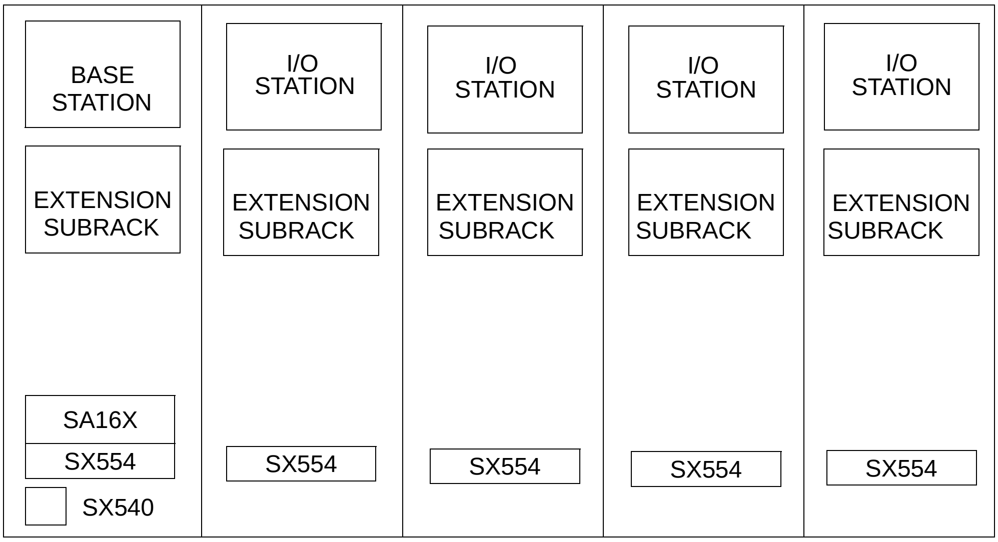


Figure C-2. Maximum Cabinet Configuration with Central Power Supply

See Section C.3, Power Supply Units SA16x and SA17x for technical data of SA16x and Section C.4, Distribution Units for Cabinets for description of distribution units SX540 and SX554.

The figure below shows a block diagram of a maximum cabinet configuration using a decentralized power supply. In station one power supply unit SA610 is used.

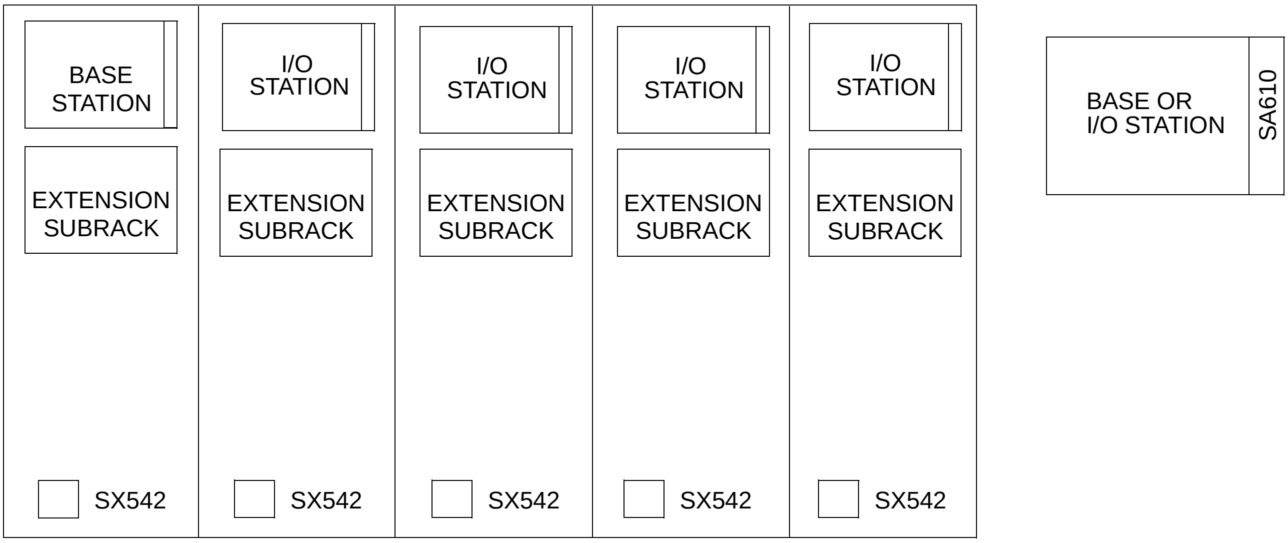


Figure C-3. Maximum Cabinet Configuration with Decentralized Power Supply

See *S600 I/O Hardware Reference Manual* for technical data of SA610 and Section C.4, Distribution Units for Cabinets for description of distribution unit SX542.

C.3 Power Supply Units SA16x and SA17x

Table C-1. Overview Technical Data for Power Supply SA16x and SA17x

Type of Power Supply	Description	Input	Output
SA161	Power supply for AC 110 and for field equipment	AC 120 V	DC 24 V, 10A
SA162	Power supply for AC 110 and for field equipment	AC 230 V	DC 24 V, 10A
SA171	Power supply for field equipment	AC 120 V	DC 48 V, 5A
SA172	Power supply for field equipment	AC 230 V	DC 48 V, 5A

C.4 Distribution Units for Cabinets

Table C-2. List of Distribution Units

Type of Distribution Unit	Description
SX540	Power switch and distribution unit, AC 250 V, 35 A
SX542	Power distribution unit, AC 250 V, 20 A
SX554	Distribution unit, DC 60 V, 430 A

The figures below show the circuit diagrams of the distribution units listed in Table C-2-2.

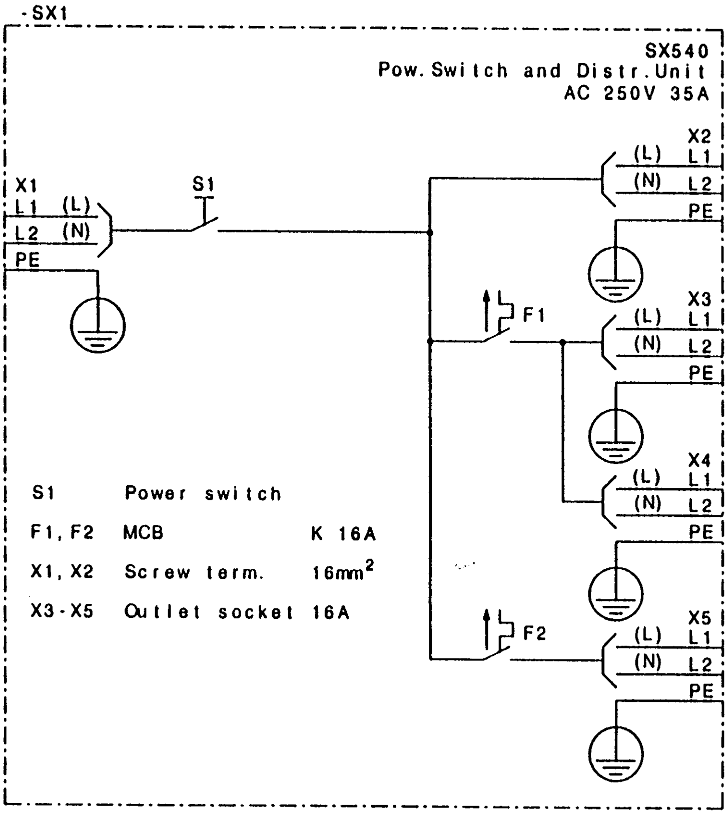


Figure C-4. Circuit Diagram of Distribution Unit SX540

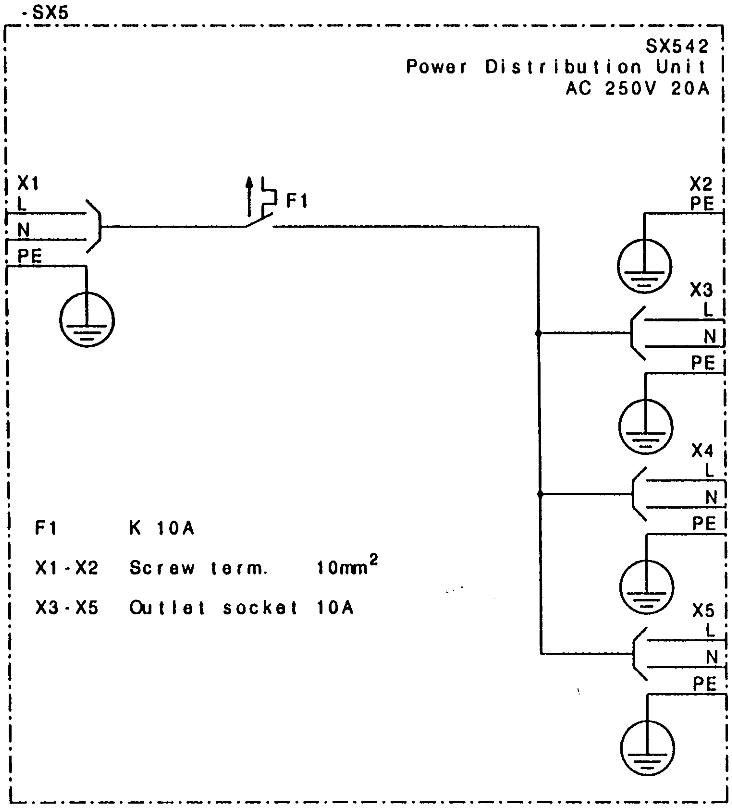
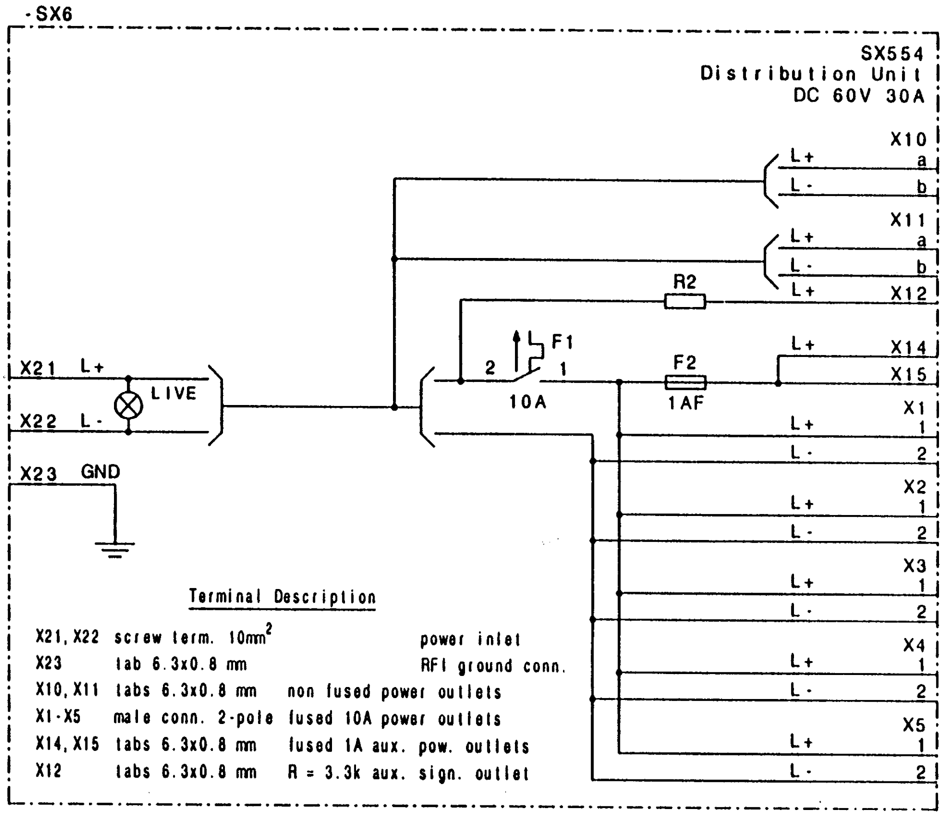


Figure C-5. Circuit Diagram of Distribution Unit SX542



Terminal Description

X21, X22	screw term. $10 mm^2$	power inlet
X23	tab 6.3x0.8 mm	RFI ground conn.
X10, X11	tabs 6.3x0.8 mm	non fused power outlets
X1-X5	male conn. 2-pole	fused 10A power outlets
X14, X15	tabs 6.3x0.8 mm	fused 1A aux. pow. outlets
X12	tabs 6.3x0.8 mm	R = 3.3k aux. sign. outlet

Figure C-6. Circuit Diagram of Distribution Unit SX554

Appendix D RM500 Cabinet - Data Sheet

D.1 RM500 Cabinets - General

The RM500 cabinet (available in three protection classes) is used for installation of Advant Controller 100 Series in control rooms. Two protection classes are ventilated, and complies with IEC 529 protection class IP 21, and IP41. The third protection class has no ventilation and complies with IEC 529 IP5. See Table D-3 and Table D-4.

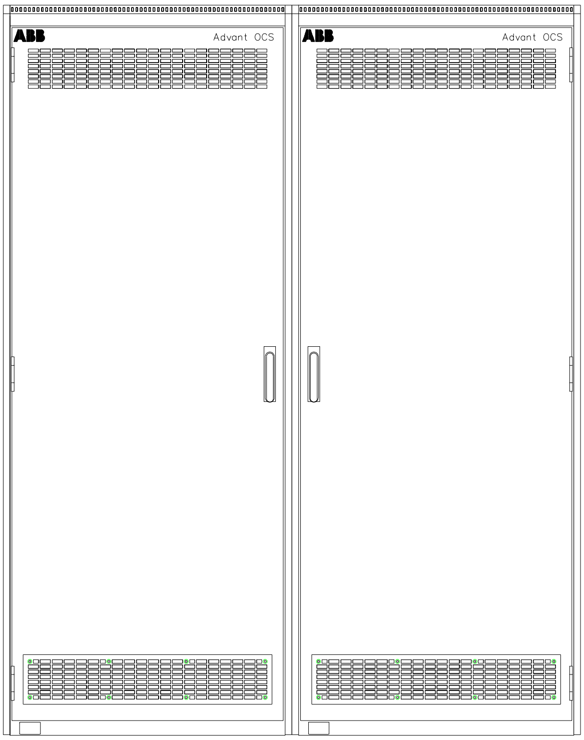


Figure D-1. RM500 Cabinet - Front View

The cabinets are delivered in a light grey RAL 7035 Structure color.

Two versions - RM500V1 and RM500V2 - with different dimensions are available (see Table D-1).

RM500V1 cabinets are provided with a single or a double door (two doors, each half the size of a single door). See Figure D-3.

All frame components are made of alu-zinc-coated steel and the welded parts are electro-galvanized.

A grounding point (an M10 screw) is located towards the front of the cabinet in the bottom left hand corner.

D.2 Dimensions and Weight

The dimension and weight of the RM500 cabinets are given in Table D-1.

Table D-1. RM500 Cabinet Measurements

Characteristics	**Cabinet Type**		
	RM500V1 Height = 1925 mm (75.8 inch.)	**RM500V1 Height = 2125 mm (83.7 inch.)**	**RM500V2 Height = 2225 mm (87.6 inch)**
Dimensions			
Cabinet(1) WxDxH	800x512x1925 mm (31.5x20.2x75.8 inch.)	800x512x2125 mm (31.5x20.2x83.7 inch.)	700x637x2225 mm (27.6x25.1x87.6 inch.)
End Panel(2) W1xD1	20x530 mm (0.8x20.9 inch.)	20x530 mm (0.8x20.9 inch.)	20x655 mm (0.8x25.8 inch.)
Cable Entry W2xD2	660x311 mm (26.0x12.2 inch.)	660x311 mm (26.0x12.2 inch.)	560x436 mm (22.0x17.2 inch.)
Weight(3)	150-200 kg (330-440 lbs)	150-200 kg (330-440 lbs)	150-200 kg (330-440 lbs)
Doors	Single/Double	Single/Double	Single
Mounting Planes	19”/24”	19”/24”	19”
U-Modules(4) Cabinet/Hinged Frame	39U/37U	43U/41U	45U/43U
Swing Radius(5)			
Single Door (SD)	793 mm (31.2 inch.)	793 mm (31.2 inch)	693 mm (27.3 inch.)
Double Door (DD)	415 mm (16.3 inch.)	415 mm (16.3 inch.)	-
Subrack (S100 I/O) in Hinged Frame (SR)	600 mm (23.6 inch.)	600 mm (23.6 inch.)	600 mm (23.6 inch.)

(1) The dimensions includes door and rear plate.
(2) W1xD1 shows the dimension for a single end panel. When mounting two end panels to a cabinet add 2x20 mm at the cabinet width, W but use D1 as cabinet depth.
(3) The weight does not include equipment to be installed within the cabinet.
(4) U-Modules, see Appendix E, Item Designations.
(5) The space required for door(s) and the hinged frame. See Figure D-3.

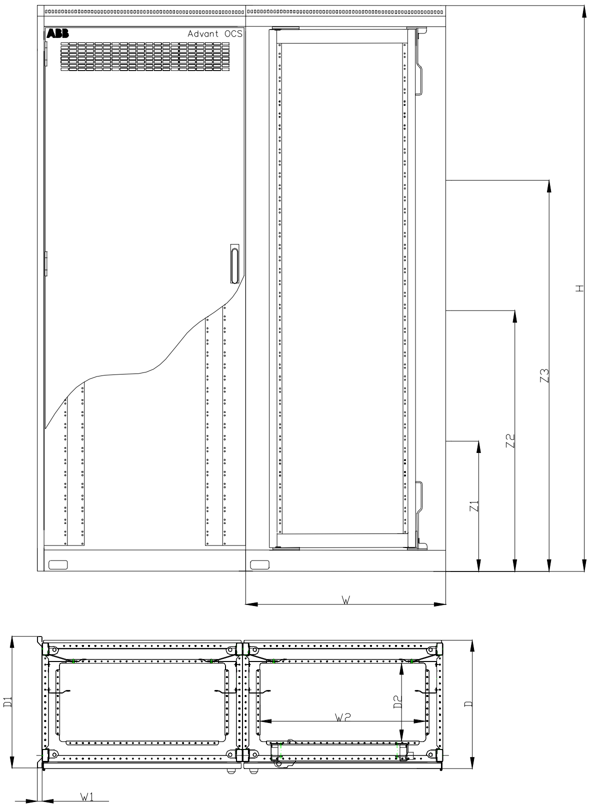
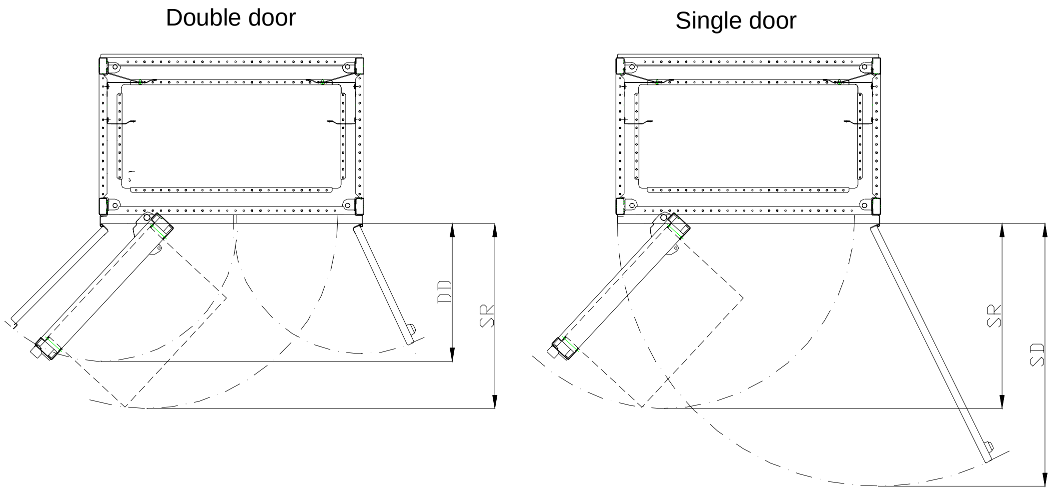


Figure D-2. Mounting Cabinets Together - Screw Position


Double door

Single door

Figure D-3. Swing Radius for Door(s) and Hinged Frame

D.3 Mounting Cabinets Together

If cabinets are to be mounted to each other use the included screw/bolt kit. The four M8 screws, with washers and nuts, in the angle hinges and six M6 screws at about Z1=500, Z2=1.000, Z3=1.500 mm height from the floor, see Figure D-2. Tighten the M8 screws to 20 Nm maximum and the M6 screws to 10 Nm maximum.

D.4 Mounting Cabinets to the Floor

When fixing the cabinet to the floor use four or six M12 screws where Figure D-4 indicates, one at each corner in the first left hand cabinet in a row of cabinets and screw the following cabinets with two screws each at the right hand side. The bottom angle hinges features holes, 14 mm (0.6”) in diameter. These holes permit you to adjust the cabinet location after holes are drilled in the floor. If drilling is necessary, make sure that no dust or other foreign matter enters the equipment in the cabinet. Please notice the minimum distances from cabinet to walls and ceiling (see Section 2.1.12, Weight and Mounting Dimensions, Figure 2-3and Figure 2-4). Use washers between the floor and the cabinet bottom to level the cabinet floor into a horizontal position.

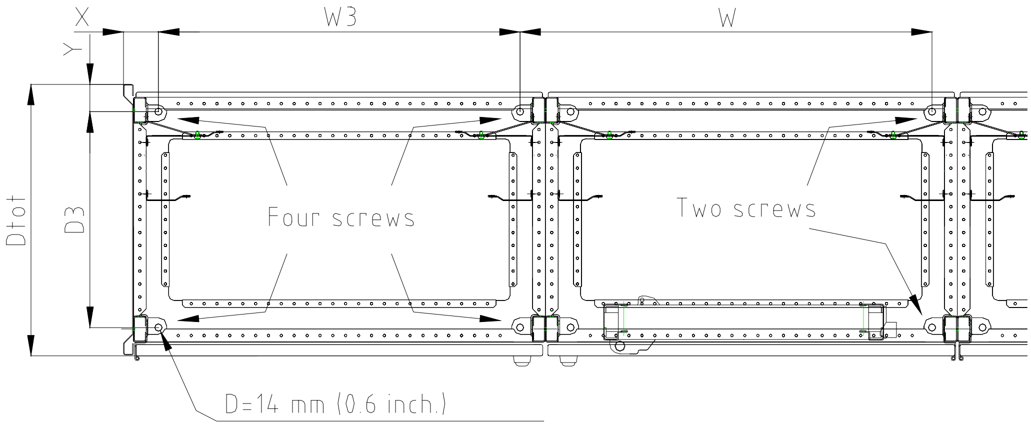


Figure D-4. Position of the Holes for Fixing the Cabinet(s) to the Floor

Table D-2. Distances in Figure D-4

Symbol in Figure D-4	RM500V1	RM500V2
X	69 mm (2.7”)	69 mm (2.7”)
W3	702 mm (27.6”)	602 mm (23.7)
W	800 mm (31.5”)	700 mm (27.6”)
Y	56 mm (2.2”)	56 mm (2.2”)
D3	419 mm (16.5”)	544 mm (21.4”)
Dtot	531 mm (20.9”)	655 mm (25.8”)

D.5 Protection Rating

Cabinets are available for different environmental protection classes, see Table D-3.

Table D-3. RM500 Cabinet Protection Classes

Type	Protection class
	RM500
Ventilated, **not** radio-proof (1) (2)	IP 21
Ventilated, radio-proof (2)	IP 21
Ventilated (3)	IP 41
Sealed	IP 54
Sealed with heat exchanger (4)	IP 54

(1) Advant Controller 450 with S100 I/O, installed in this cabinet is **not** verified for CE-marking.
(2) Standard cabinet without filter on ventilation grilles.
(3) Ventilation grilles are covered with metallic net to prevent insects to enter the cabinet. A heater is included to heat the cabinet when the controller is not in use.
(4) Available as a standard sealed cabinet with heat exchanger as an option.

Table D-4. Available Degree of Protection Ratings for RM500

	RM500V1 H=1925 mm (75.8 inch.)			**RM500V1 H=2125 mm (83.7 inch)**			**RM500V2 H=2225 mm (87.6 inch.)**		
	IP21	**IP41(1)**	**IP54**	**IP21**	**IP41(1)**	**IP54**	**IP21**	**IP41(1)**	**IP54**
Cabinet with or without hinged frame	X	X	X	X	X	X	X	X	X
Cabinet for OOCU	X	X	X	X	X	X			
Cabinet, NOT verified for CE marking	X			X			X		

(1) IP41 includes a heating element, and the ventilation grilles are covered with nets.

D.6 Permitted Power Dissipation

The permitted power dissipation in a single RM500 cabinet is given in Table D-5 If required, due to environmental conditions, use Protection Class IP54.

Table D-5. Permitted Power Dissipation for RM500

Protection Class	15^{o} C Temperature Rise	30^{o} C Temperature Rise
IP21	700 W	1.400 W
IP41	500 W	1.000W
IP54	300 W	600 W

The CPU subrack is provided with a fan unit to equalize the temperature difference in the subrack.

Appendix E Item Designations

E.1 General

To use the documents provided at delivery, you must be familiar with the item designation system used in Advant Controller cabinets.
Each component in the system has a unique designation which indicates exactly the location of the component in the cabinet. This designation consists of a letter followed by a numerical combination. The letter specifies the mounting plane, and the numbers designate the level in the cabinet and the position in the cabinet.

This description applies to cabinet type RM500 and Advant Controller 100 Series.

E.2 Cabinet

Mounting planes in cabinets are designated as shown in Figure E-1.

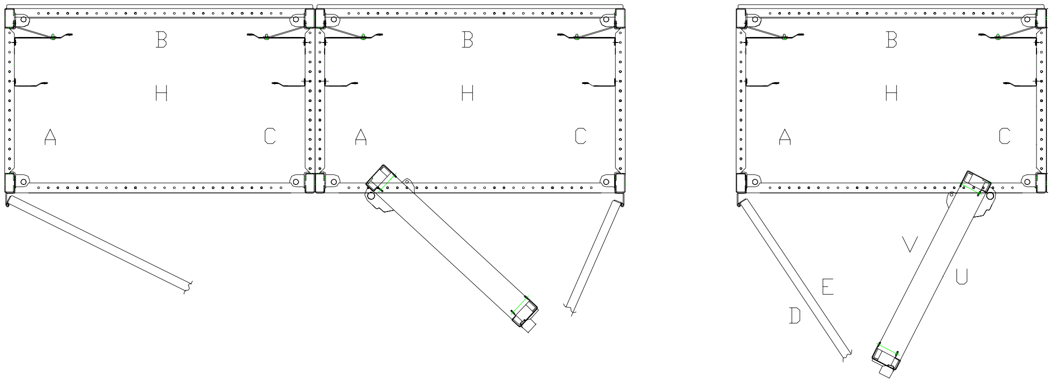


Figure E-1. Item Designation of Mounting Planes

A = left-hand side of cabinet

B = rear mounting plane, 19”

C = right-hand side of cabinet

D = front of door

E = rear of door

F = optional location, free

H = extra mounting plane in front of B, 24”

T = ceiling location

U = front of hinged frame, 19”

V = rear of hinged frame, 19”

When there are several cabinets, they are designated 1 and 2 from the left.
The mounting planes are for example 1B, 2B etc.

All mounting planes A, B, C, D, E, H, V (hinged frame) and U (hinged frame) are divided vertically into eight modules (U), 1U = 44.45 mm (see Figure E-1).

Mounting planes B, U and V are for 19” units and H is for 24” units.

The mounting planes A and C have a horizontal partition of 25 mm. They are numbered 1, 2, 3 etc. from the rear and forward (see Figure E-1).

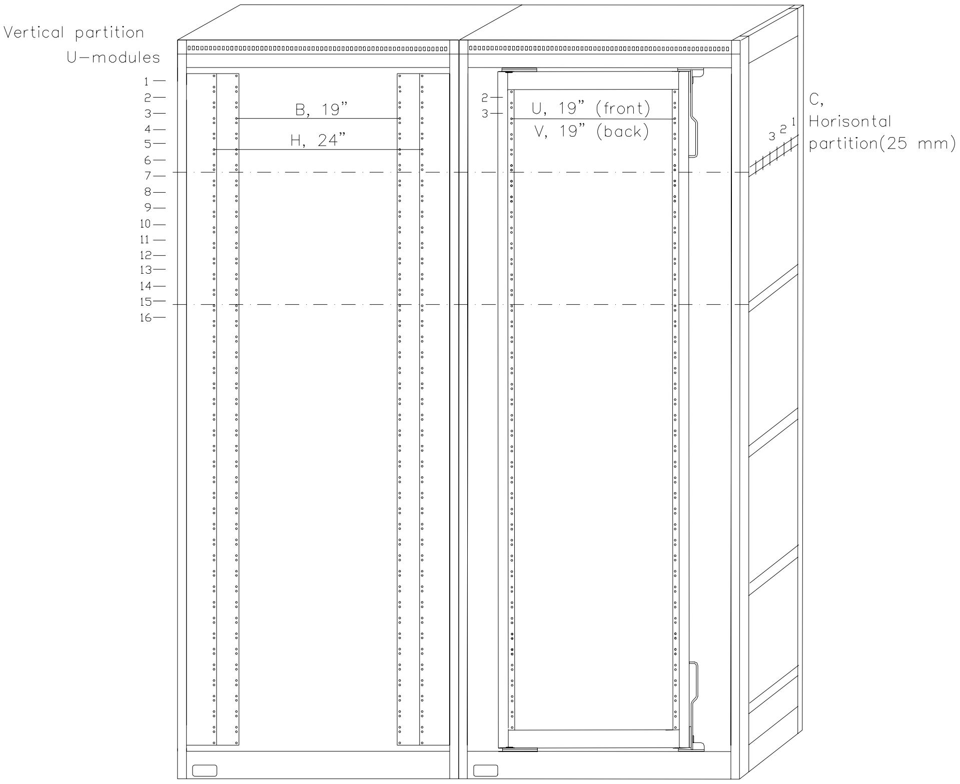


Figure E-2. Cabinet with Door Removed

The levels specified are those of the upper left-hand corners of the units installed.

The cabinet is designated with a letter combination followed by figures. The + sign prefix indicates that the designation is location-oriented.

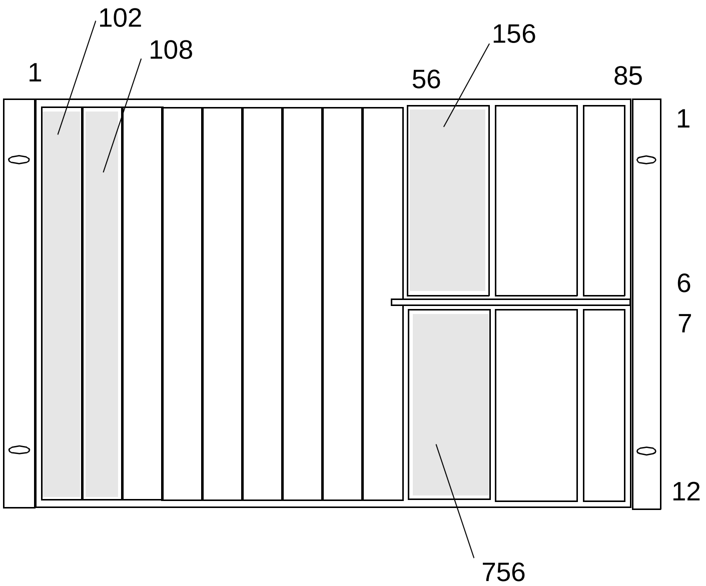
E.3 Controller Subracks

The controller subracks are 12 and 18 SU modules high (1 SU = 25 mm) and 85 mp modules wide (1 mp = 5 mm).

Subracks have 14 slots for modules, center-center spacing 6 mp (general design).
Variants of module height and width exist (6 mp and 12 mp).
The disposition of the subracks in terms of number of relevant modules are specified in the respective product documentation.

Location-Oriented Item Designations

The first module in a controller subrack is designated 102, the next 108, etc.



Please note!
The given location-oriented item designation should not be mixed up with the module item designation in the computer infrastructure (address) where the positions are designated from the left 1, 2, 3, etc.
See Figure E-5

Figure E-3. Item Designation in Controller Subrack 12 SU

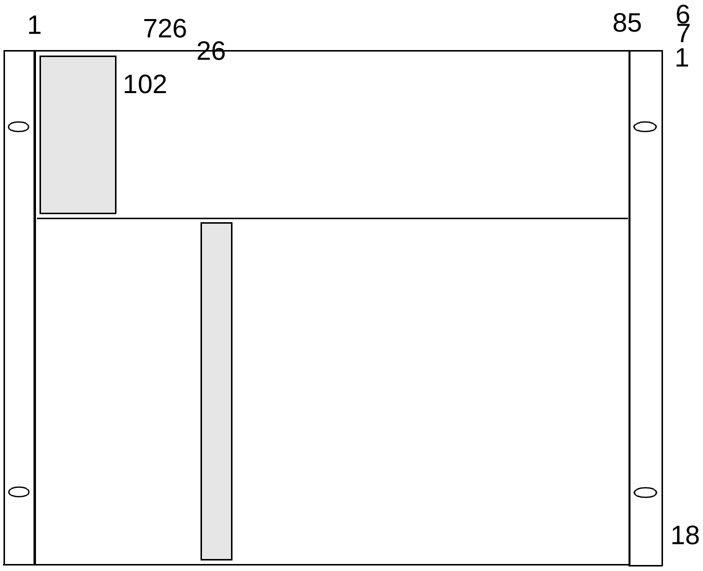


Figure E-4. Item Designation in Controller Subrack 18SU

Address

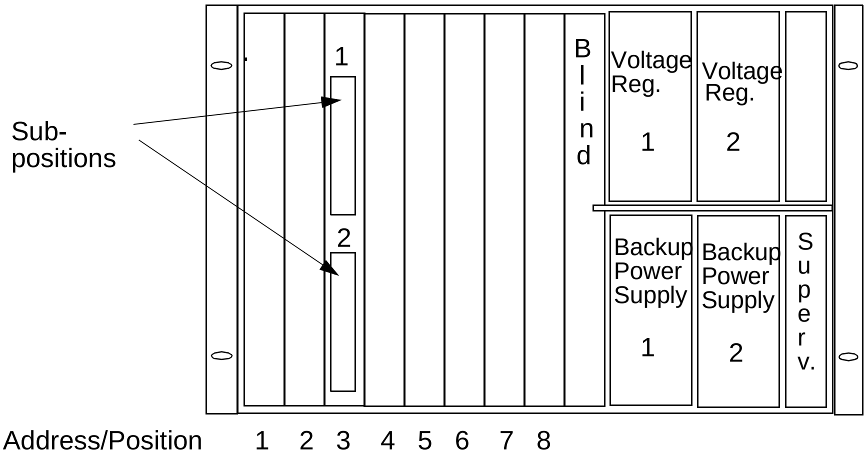


Figure E-5. Addresses in Controller Subrack 12 SU

E.4 I/O Subracks

The I/O subracks are 8 (U) modules high (1 U = 44.45 mm), including cable duct.

Subracks have 21 slots for modules.
The first module in a subrack is designated 101, the next 105, the next 109, etc. See Figure E-6.

The item designation of the modules gives their location in the subrack. The module marked in the figure is at module location 25. The 1 in the designation refers to the uppermost level, level 1 in the equipment frame.

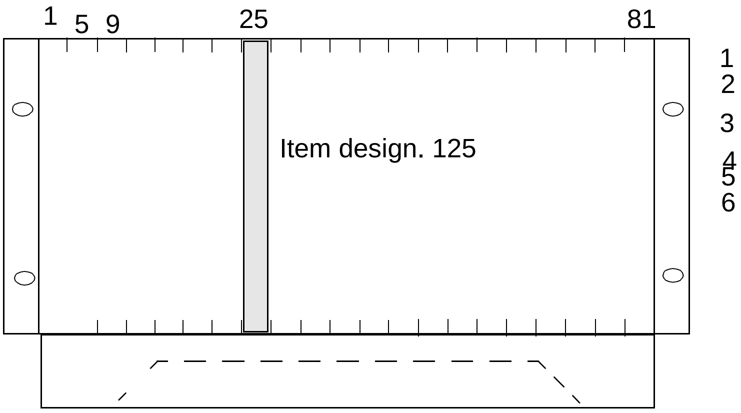


Figure E-6. Item Designation in I/O Subrack

E.5 Modem Subracks

The modem subracks are 6 (U) modules high (1 U = 44.45 mm), including cable duct.

Two wide variants are available, 19 inches and 24 inches.

The places in the subrack for modems have sequential numbers 1 - 9 and 1 - 12. Places 10, 11 and 13, 14 are contacts for power supply distribution (24 V).

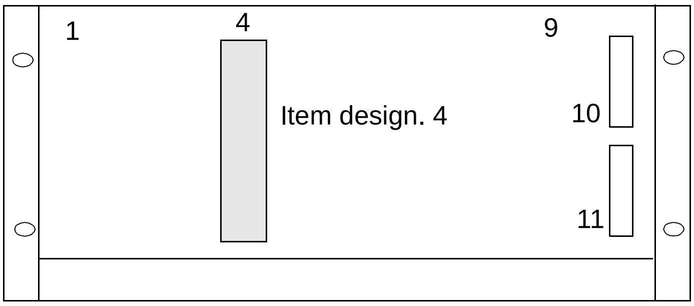


Figure E-7. Item Designation in Modem Subrack, 19 inches

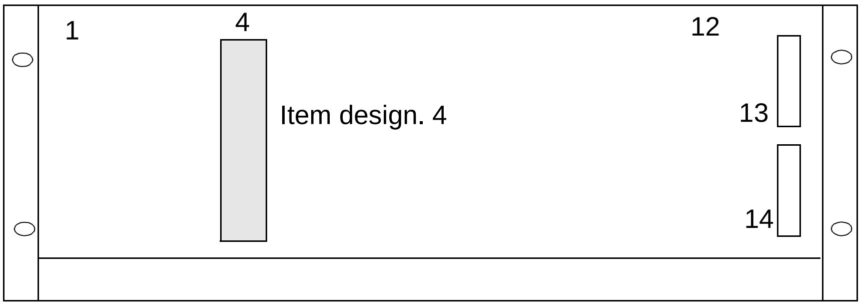


Figure E-8. Item Designation in Modem Subrack, 24 inches

Modems mounted on a bracket are numbered 1 and 2 as in Figure E-9.

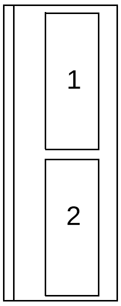


Figure E-9. Modem Mounted on a Bracket

E.6 Circuit Boards and Units

Connectors on the Front

Connectors on the front are numbered X1, X2, etc., from the top downward. With several circuit boards in a unit, the boards are designated 1, 2, 3, etc., and the connectors on the different boards are designated X21, X22, X31, etc.

Other plug-in circuit boards in the front of the units have sequential numbers 1, 2, 3, etc.

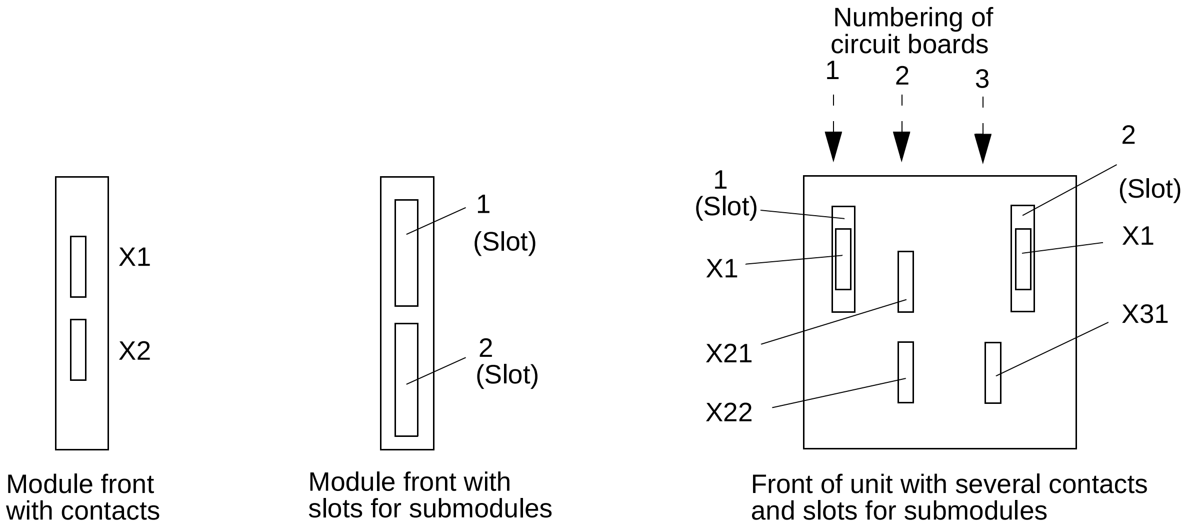

X1
X2
Module front with contacts
1 (Slot)
2 (Slot)
Module front with slots for submodules
Numbering of circuit boards
1
2
3
1 (Slot)
X1
X21
X22
2 (Slot)
X1
X31
Front of unit with several contacts and slots for submodules

Figure E-10. Numbering of Submodules and Connectors on the Front

Connectors on the Rear Side

Connectors are numbered X1, X2, etc., from the top downward.

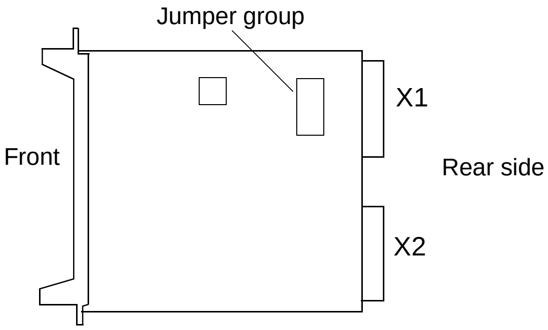


Figure E-11. Numbering of Connectors on the Rear Side

Connection Units

The item designation code for the contacts of the connection unit are shown in Figure E-12. The connector for internal connections in the cabinet is always designated X80.

The terminal block group or connector for external connections is designated X90. If there are more connectors, these are designated X81, X82, etc., or X91, X92, etc.

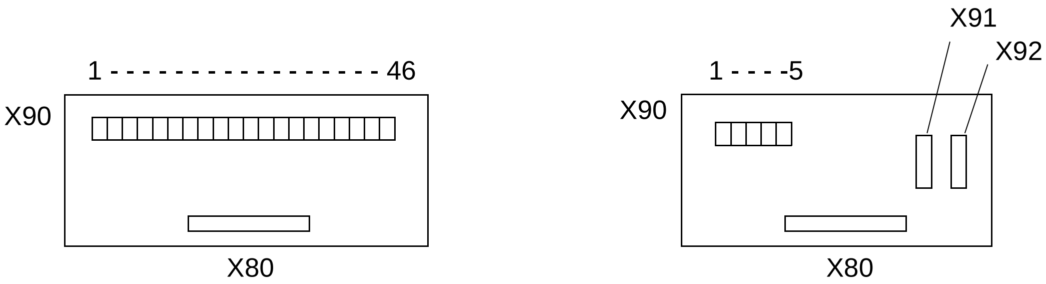


Figure E-12. Connection Units, Connection and Terminal Numbering

When more than one connection unit is mounted on the same mounting bar, the units are numbered as follows:
The mounting bar for connection units is divided in width modules à 20mm, which is a multiple of the standard connection unit width.

19 inch	24-width modules
24 inch	30-width modules

The item designation specified for a connection unit is that module number covered by the upper left-hand corner of the unit installed.

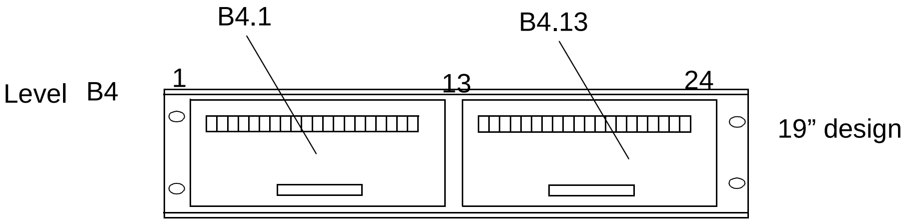


Figure E-13. Location of Connection Units on a Mounting Bar

Figure E-14 shows a typical connection between connection unit B1.1 and I/O board U4.125. The item designation of the board gives its location in the subrack.

This connection is designated U4.125.X2 - B1.1.X80.

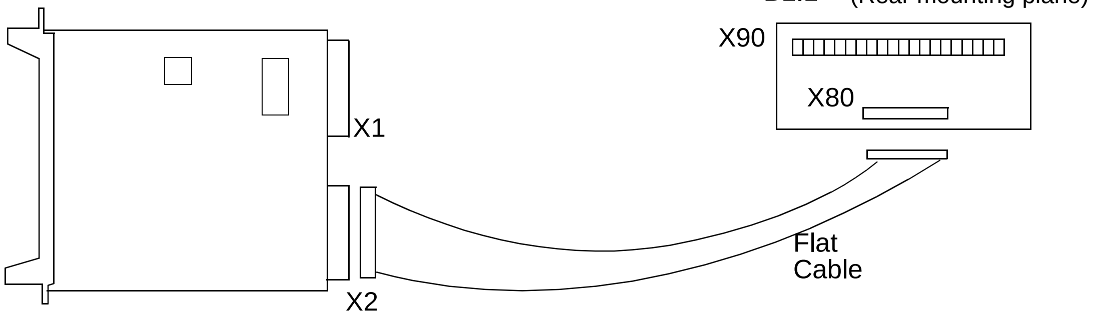


Figure E-14. Typical Internal Connection

The poles of the connection terminal block on the connection unit are numbered from left to right, see Figure E-15. The code for a process connection to pole 3 becomes B1.1.X90:3.

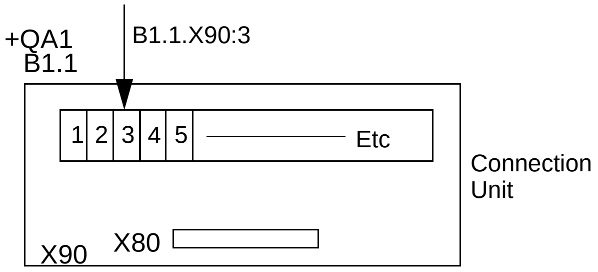
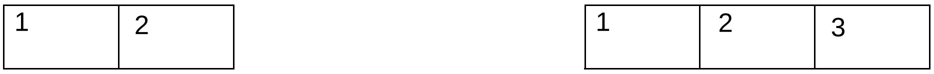


Figure E-15. Terminal Block Numbering

E.7 Mains Units



Mounting plate 19”

Mounting plate 24”

Figure E-16. Location of Mains Units

The mounting plates can carry two or three mains units. The mains units are numbered 1, 2, 3, as in the figure. The mounting plates are 3 U high.

E.8 Examples of Item Designation in Cabinets

A number of modules, connection points, etc., located in a double cabinet are illustrated in Figure E-17.

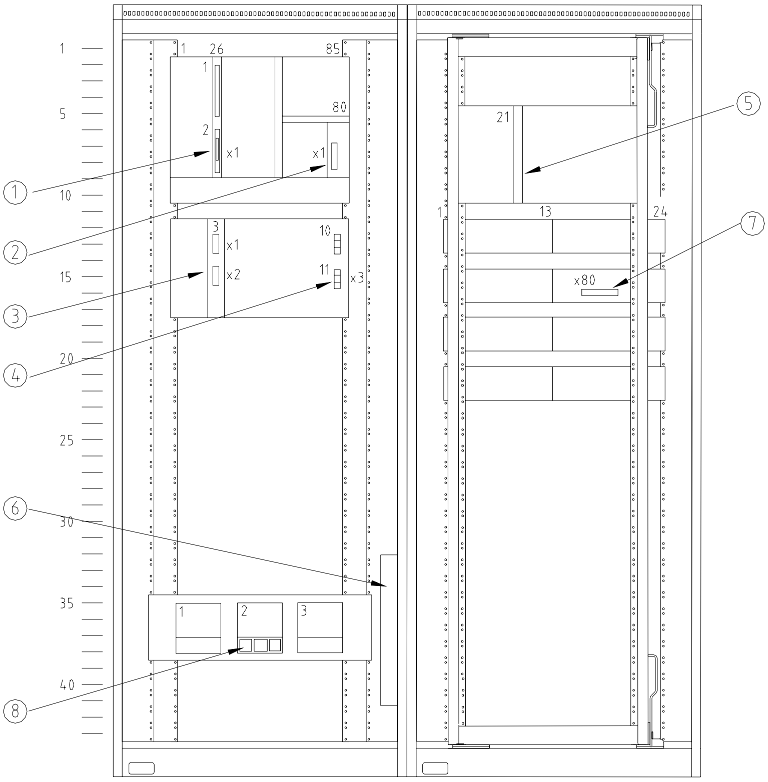


Figure E-17. Example of General Disposition of a Double Cabinet

An extract from a wiring table, Table E-1, shows the corresponding item designations, *Table E-1. Designation of Items in Figure E-17*

No.	**Instar.**	**Connection point A**				
		Item designation				**Terminal**
	1		1B2	126	2	X1
	2		1B2	780	X1	
	3		1B12	3	X2	
	4		1B12	11	X3	
	5		2U5	121		
	6		1C32.**x**(1)		X1	
	7		2H15	13	X80	
	8		1H35	2	F1X3	

(1) **x** stands for 1, 2, 3 etc.

Appendix F Delivery Documentation

F.1 Delivery Binder Content

As a complement to the user documentation, there is a binder which contains other pertinent documentation related to the delivery. This pertinent documentation is referred to as the **Delivery Binder**.

The Delivery Binder has the same content structure for all Advant products.

The Delivery Binder includes the following documents:

1. **Order Reference Sheet**
   A document which contains the ABB order reference number. This number serves as the basis for all subsequent references to this delivery.
2. **Delivered Version Specification**
   A document which contains the general system release information.
3. **System Log**
   This is a series of blank forms suitable for logging hardware and software repairs, modifications, or expansions of the product. These forms are used by the service engineers in the initial commissioning as well as by customers after delivery from ABB.
4. **Delivery Specification**
   The information in this document specifies all parts of value which are included in the initial delivery (the actual List of Apparatus).
   When subsequent changes to the product occur, the list of new parts is included here, too.
5. **License Certificate**
   This certificate is the end user's evidence that he has purchased the right to use the specified (software) products. The document contains the end user name and a list of the particular software packages under license, as well a list of our standard terms and conditions.
6. **Inspection and Test Record**
   This document, filled in by the production department, specifies which test specifications and delivery test procedures the equipment has been subject to.
7. **Release Notes**
   Latest product information which is not covered by the standard user documentation.
8. **Terminal Diagram**
   A block diagram where all hardware modules (circuit boards and units) are represented by functional symbols and where all interconnections between the modules are shown. The diagram is mainly used at installation, commissioning, and system maintenance (fault finding).
9. **Support and Problem Reporting**
   Includes information and instructions on how to get support from ABB and how to report problems with the product and its functions. Forms are available for problem reporting.

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